THURSDAY, JULY 20, 1893.

VERTEBRATE EMBRYOLOGY.

Vertebrate Embryology. By A. Milnes Marshall. (London: Smith, Elder, 1893.)

THIS is an eminently practical treatise, designed to assist the senior university student in his laboratory work so as to enable him to gain a thorough knowledge of the successive appearances of the embryos of amphioxus, the frog, the chick, the rabbit, and man, during their course of development from the egg to the adult form. The student is supposed to pursue his studies by the aid of the most modern methods, and he has here placed before him by means of clear methodical description and clever original drawings exactly what he ought to see and identify in his series of microscopic sections. The book will be extremely useful, as are the author's other treatises, to all teachers and students of biology. It should be pointed out that very considerable pains has been taken by Prof. Milnes Marshall to give accuracy and reality to his statements. Especial care has been given to the account of the embryology of the frog, which is illustrated by admirable original drawings and may be regarded as a critical revision of the subject based upon original work carried out by the author and his pupils. Most of the novel features in the chapter on the chick are derived from the work of Duval, but in the later stages of the rabbit's development Prof. Marshall again relies on his own observations and drawings. The account of the human embryo is based upon that of Prof. His with some judicious additions.

I have said that the work is eminently practical, and by that I mean not only that the book is one for the laboratory, but that the author whilst giving the greatest care to accuracy of statement and presentation of fact, has dealt very little—I may even say has avoided dealing—with theoretical questions of wide interest. An introductory chapter in some thirty pages gives a brief and general sketch of the structure of the animal egg, its maturation, its fertilisation, the segmentation of the egg and the germ layers, theories of fertilisation and recapitulation and the origin of sex, and then we settle down to our "types."

I do not doubt that the plan of teaching by "types" has its merits, and has served a very useful purpose; also I cannot doubt that the plan of describing all the phases of an animal's growth (except the adult phase) in order, one after another, has advantages, and perhaps such descriptions constitute—if such a study can really be distinguished and recognised—what is known as "embryology." But it becomes daily more obvious that the histology, morphology, and physiology of the organism must also be considered and treated without regard to the arbitrary separation of adult and embryonic conditions, and without that exclusiveness which the selection of "types" involves. Morphology is essentially *comparative;* it involves the consideration alike of embryonic and adult structure, and must avail itself of the facts of structure exhibited in any and all forms, without being restricted to certain types. It is a consequence of the method of treatment adopted by Prof. Marshall that many interesting morphological problems are not discussed by him. It clearly was not his purpose to consider these problems, but rather to furnish the student with a sound basis of observed fact. At the same time it is a little disappointing—on looking up, in the successive chapters on frog, chick, and rabbit, the account of the development of the urinary and genital ducts—to find no discussion or decisive statement on the author's part as to the morphological relation of these structures, or any suggestion as to the explanation of the divergences in the developmental history of the Müllerian and Wolffian ducts in these "types" respectively, and in other vertebrates. In a work on vertebrate embryology one might reasonably expect such a comparative treatment. Similarly, the question of blastophore and primitive streak and "sickle" is but lightly touched, whilst the conflicting and bewildering accounts of the germinal layers of the mammalian blastoderm are left without further remark than that the account adopted from Rauber and Kölliker, as to what takes place in the rabbit, "is difficult to reconcile with the course of development in other mammals; and further investigation is much needed on these points." It could not be expected that Prof. Marshall should settle in the present treatise all the knotty points of vertebrate embryology, but would it not have been well had he pointed out in some detail the difficulties of reconciliation to which he briefly alludes, and given some indications of alternative solutions of the problems involved? These reflections are by no means to be regarded as depreciation; they are rather intended to illustrate the special lines within which the author has confined his treatise. These being given, it is not too much to say that he has produced a most valuable, clear, and masterly exposition of the known facts of the developmental history of leading types of vertebrata.

Before concluding I may venture to point out two matters which might be amended in a new edition of the book, as well as in the same author's "Practical Zoology." The word "stomatodæum" occurs in several places. There is no reason that I know of for altering the more elegant form "stomodæum" in this way: the one is as "correct" as the other. Being the father of the word "stomodæum" and its twin "proctodæum," I should prefer that those who use it would not delude themselves into the notion that I have inadvertently or ignorantly omitted a necessary syllable in its composition. The second matter is as to Prof. Marshall's figures of transverse sections of adult Amphioxus (Figs. 12 and 13). These require (and have for some time required) correction. The clear space below the black undulated line representing the plaited epithelium of the ventral surface of the atrium should be filled in with shading. It is *not* a space, as it was at one time thought to be, but is a solid mass of gelatinous connective tissue. Moreover, the dotted area marked S in both the figures is not, as the explanation of the figure has it, the cardiac aorta. The space so marked is the sub-endostylar cœlomic space, and the cardiac aorta, which is a relatively small vessel lying within it, is not represented in the figures at all.

E. RAY LANKESTER.

RURAL HYGIENE.

Essays on Rural Hygiene. By George Vivian Poore, M.D., F.R.C.P. (London: Longmans, Green, and Co, 1893.)

EIGHT of the chapters of this work have been, in whole or part, previously published; to these the author has added five others, and the result is a welcome volume, which appeals to all those who take an interest in problems of health.

To the lay reader the book will probably carry conviction upon every one of the many sanitary points which are raised and dealt with, for the writer has a style which is at once clear, incisive, and convincing; and he builds up his conclusions upon good, sound, scientific, and logical bases. Many professed sanitarians will, however, cull here and there from among much which they are unhesitatingly prepared to accept, a little which is not in entire accordance with their own tenets and experience, but which is none the less acceptable as affording much food for thought and speculation.

The keynote struck throughout the work has a genuine ring, for the dominant principles of *rus in urbe* and *urbs in rure* resound through every chapter.

The first chapter deals with the concentration of population in cities, and the author very justly finds great fault with the overcrowding on space that now obtains, and he indicates, upon sound sanitary lines, the conditions which should be imposed to obviate this evil. The advice, however, comes too late for many of our large towns, in which, alas, at the present day, hygiene must needs make way for measures of expediency. Later on, in a capital chapter on "Air," the author resumes his diatribe against overcrowding, and even goes to the extent of facing it in our conventional "at homes." He writes: "Perhaps the day will dawn when it will be considered 'bad form' to give your guests far less than one-twentieth of the fresh air which is allowed to criminals." One is not prepared to unreservedly accept the view that water under pressure and the laying down of sewers have been mainly instrumental in causing overcrowding on space. There can be no gainsaying that our towns, long before the era of the introduction of these two systems, were miserably overcrowded; and there is no reason to doubt that, apart from either of these innovations, the towns would have continued to spread with little or no improvement in this respect, and that, despite the absence of water under pressure, the value of land over certain favoured areas would have insured the appearance of the modern high buildings.

The following principles are powerfully advocated throughout the book: The shallow-earth burial of dead bodies; the payment of water by meter on a sliding scale of charges, giving the "water of necessity" at a low rate, and charging more for the "water of luxury"; that each individual should have at least two-thirds of an acre of land, so as to secure an adequate supply of fresh air, and to provide that all refuse of every kind might be returned to this land in order to maintain and increase its fertility.

The two chapters that deal with personal experiences in a country town are extremely interesting and instructive, as giving the author's experience of a small estate of his own, upon which about a hundred people are housed, and in which he endeavoured—with no small measure of success—to realise his Utopia, *i.e.* a place where there are no sewer pipes; where every cottage has around it an allotment sufficient to be fertilised by, and to purify, all the waste products furnished by the inmates; and in which the waste waters should run "clear as crystal in open channels without needing so-called ventilation."

Throughout the book many interesting agricultural points are raised and treated ably by one who is evidently able to bring considerable practical experience in harmony with theory.

To sum up:—The book is eminently interesting; it is instructive and furnishes much food for the reflective mind, and as such its perusal may be confidently recommended to one and all.

OUR BOOK SHELF.

Die Klimate der Geologischen Vergangenheit und ihre Beziehung zur Entwickelungsgeschichte der Sonne. Von Eug. Dubois. (Nijmegen: H. C. A. Thieme. Leipzig: Max Spohrr, 1893.)

THIS pamphlet is a translation, with additions, of a paper originally published in the Journal of the Dutch East India Company. It consists of two portions of somewhat unequal value and interest. In the first section of the book, extending to thirty-six pages, a short but clear summary is given of the evidence bearing on the question of the climate of former geological periods. The references and notes display complete familiarity with the very large literature which is now in existence in connection with this subject. The second and larger half of the pamphlet, extending to nearly fifty pages, is a well-reasoned development of the theme that the variations in the temperature of the earth's surface during successive geological periods were the result of changes in the heat of the sun, and that the sun is in fact a variable star. Anyone wishing to become acquainted with all the recent facts and arguments bearing on the question of the climate of former geological periods, and to find them carefully summarised, with abundant references to original sources of information, will in this little pamphlet recognise a work admirably adapted to his needs.

Polarization Rotatoire, Réflexion et Réfraction vitreuses, Réflexion métallique. Par G Foussereau. (Paris: Georges Carré, 1893.)

THIS volume consists of a series of lessons given at Sorbonne in 1891-92 to *candidats à l'agrégation.*

Under natural rotatory polarisation the author deals with the fundamental phenomena presented by quartz when traversed by polarised light parallel to the optic axes, and discusses the theories of Fresnel and others relative to rotatory polarisation. The relations between activity and crystalline form, the rotatory power of liquids, and the behaviour of quartz when traversed by light in a direction inclined to the optic axis, are also treated in this section.

Magnetic rotatory polarisation in singly- and doubly-refracting media is discussed in the second part. In both of these sections the effects of the various factors upon which the magnitude of the rotatory power depends—wave length of the light employed, temperature, length and chemical nature of the medium, &c.—are briefly stated.

In the last part is found a discussion of the various hypotheses advanced in connection with the phenomena

of vitreous reflection and refraction and of reflection at metallic surfaces.

The book contains a clear account of the theoretical aspects of the above questions, the mathematical treatment being as elementary as is consistent with the nature of the subject.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications.*]

The Non-Inheritance of Acquired Characters.

I WISH to call the attention and elicit the opinion of naturalists as to the interpretation of certain facts bearing upon this question.

In my article in the *Fortnightly Review* of May last, p. 664, I give what appears to be a new interpretation of facts which have been often quoted, as to the change in the external characters of a Texan species of Saturnia when the larvæ were fed upon *Juglans regia*, its native food-plant being *Juglans nigra;* and the somewhat analogous facts as to *Artemia salina* being changed into *A. Milhausenii* (the former living in brackish, the latter in salt water) when the water became gradually more salt; the change in this case being progressive, year by year, and proportionate to the change in the saltness of the water. The reverse change was also effected by gradually reducing the salinity of the water inhabited by *A. Milhausenii.*

As regards the former case I remarked in my article as follows:—

"Prof. Lloyd Morgan (in his 'Animal Life and Intelligence,' pp. 163–166) clearly sees that this and other cases do not prove more than a modification of the individual; but it seems to me to go further than this. For here we have a species the larvæ of which for thousands, perhaps millions, of generations have fed upon one species of plant, and the perfect insect has a definite set of characters. But when the larvæ are fed on a distinct but allied species of plant, the resulting perfect insect differs both in colouration and form. We may conclude from this fact that some portion of the characters of the species are dependent on the native food-plant, *Juglans nigra*, and that this portion changed under the influence of the new food-plant. Yet the influence of the native food-plant had been acting uninterruptedly for unknown ages. Why then had the resulting characters not become fixed and hereditary? The obvious conclusion is, that being a change produced in the body only by the environment, it is not hereditary, no matter for how many generations the agent continues at work; in Weismann's phraseology it is a somatic variation, not a germ variation."

I then referred to the marked difference between somatic and germ variations in plants, the former disappearing at once, the latter persisting, when cultivated under abnormal conditions; and also to the cases of many closely allied species of animals and of the races of mankind, which preserve their distinctive characteristics when living and breeding under very different conditions.

The above seems to me a perfectly valid and logical argument, and I was interested to see how it would be met by Lamarckians, who have frequently referred to the same facts as being obviously in their favour, though without any attempt to show how and why they are in their favour. I was therefore rather surprised to read, in the July issue of the *Contemporary Review*, a paper by Prof. Marcus Hartog, in which he characterises my argument as a very bad kind of special pleading, and adds that it amounts to this: "Any change in the offspring produced by altered conditions in the parent is limited to characters that are 'not fixed and inherited'; for fixed and inherited characters cannot be altered by changed conditions in the parent; therefore no experimental proof can be given of the transmission of acquired characters."

The above is of course simple reasoning in a circle, and I cannot recognise it as my reasoning. I have made no general proposition that "fixed and inherited characters cannot be altered by changed conditions in the parent," or that "no experimental proof can be given of the transmission of acquired characters." But I argue that when a decided character is immediately changed by changed conditions of the individual, as in Saturnia, it is not "fixed and inherited." The experiment itself shows that it is not a fixed character, and there can be no proof that it is inherited so long as it only appears under the very same changed conditions that produced it in the parent.

As to experimental proof I believe it to be quite possible. There is one case, which I do not remember having seen referred to, in which nature has tried an experiment for us. I was informed by the President of the Deaf-Mute College at Washington that the male and female students frequently marry after leaving the college, and that their children are rarely deaf-mutes. But the point to which I wish to call attention is the admitted fact that there is usually no disease or malformation of the vocal organs in a deaf-mute. Now, before deaf-mutes were taught to talk as they are now, they passed their whole lives without using the complex muscles and motor-nerves by the accurate coordination of which speech is effected. Here is a case of complete disuse, and there must have been some consequent atrophy. Yet it has, I believe, never been alleged that the children of deaf-mutes exhibited any unusual difficulty in learning to speak, as they should do if the effects of disuse of the organs of speech in their parents were inherited. Here is at all events the material of an experiment ready to our hands. An experiment to show whether the effects of use and disuse were inherited might also be tried by bringing up a number of dove-cot pigeons in a large area covered in with wire netting so low as to prevent flight, at the same time encouraging running by placing food always at the two extremities of the enclosure only, or in some other way ensuring the greatest amount of use of the legs. After two or three generations had been brought up in this way, the latest might be turned out among other dove-cot pigeons, at the age when they would normally begin to fly, and it would then be seen if the diminished wing-power and increased leg-power of the parents were inherited.

No doubt many better experiments might be suggested; but these are sufficient to indicate the character of such as do not require that the offspring be submitted to the same conditions as those which produced the change in the parents, and which thus enable us to discriminate between effects due to inheritance and those due to a direct effect of the conditions upon the individual. The cases of the Saturnia and the shrimps are of the latter kind, and in their very nature can afford no proof of heredity.

ALFRED R. WALLACE.

The Conditions Determinative of Chemical Change: Some Comments on Prof. Armstrong's Remarks.

IN a paper (NATURE, vol. xlviii. p. 237, Proc. Chem. Soc. 1893, 145) bearing the above title, Prof. Armstrong discusses the phenomena of contact action, particularly those of the kind described by Mr. H. B. Baker. The whole discussion appears to us to be based on erroneous conceptions and to call for some criticism, first, on the general position assumed by him and, second, of the details which he brings forward to support that position.

Eight years ago Prof. Armstrong defined chemical action as "reversed electrolysis." It is not clear from his remarks whether this is one of the views which recent observations have led him to modify; but, assuming that he still holds that belief, it may be pointed out that it by no means follows that because an electric current can effect a chemical change, every chemical change is due to or accompanied by electric action. It might as well be argued that because a stone let fall on a glass plate can shiver it, a shivered plate glass always implies a falling stone as its cause—it could be broken by irregular rise of temperature, or by loading it with a too heavy weight, phenomena which imply no expenditure of kinetic energy. Yet the statement contains a germ of truth, but only when so qualified as to amount to something very different. Electrical energy may be absorbed in effecting chemical decomposition; when chemical combination occurs *some form of energy* is made manifest. The facts, apart from theory, as we know them, appear to be these. A certain fraction of some definite amount of electrical energy may be absorbed in producing chemical decomposition, and that fraction will be quantitatively converted into chemical energy; the electrical energy disappears as such, and elements may be liberated from a compound, containing, as elements, the equivalent quantity of chemical energy. These elements may part with their chemical energy, which will then cease to exist

as such, but will appear in various forms: some of it may be evolved as heat, some as volume energy, some as kinetic energy, and it is even possible by an appropriate contrivance to obtain a large portion of the chemical as electrical energy. But to state that the energy always passes through the electric stage on its way to other forms in which it manifests itself to us is something altogether different.

The question that Prof. Armstrong tries to answer by the supposition that the presence of an electrolyte is required in order to bring about chemical change admits of a very different reply. We conceive it to be this: In most exothermic combinations the heat evolved is sufficient, provided the change were to proceed adiabatically, to resolve the compound into its constituents. Why, then, should they react? To take a concrete instance:—Why should ammonia and hydrochloric acid combine at ordinary temperatures when the heat evolved by their union is sufficient (*provided none escape*) to raise the reacting molecules to the temperature at which they refuse to combine? For convenience sake the question is stated in terms of heat, since that is the usual form in which the loss of chemical energy manifests itself to us; but it is advisable to keep the statement of the question quite general. It appears to us that the answer is:—because the reaction is not adiabatic. Some substances must be present—the walls of the containing vessel, some compound capable of dissociation, some solid body, such as spongy platinum, which will absorb a portion, perhaps an exceedingly small portion, of energy, and so give the bodies present a chance of interacting without liberating so much energy by their interaction as would decompose the prospective compound. These views, it may be contended, are speculative. It is true: but we venture to think that they are legitimate speculations, involving a complete survey of the circumstances, and not one-sided and partial like those of the paper we are criticising.

Assuming the correctness of Prof. Armstrong's main idea, there are still one or two matters of detail where the assumption scarcely seems in harmony with known facts. He assumes that because hydrogen chloride when dissolved in water forms a composite electrolyte, a gaseous mixture of hydrogen chloride and water will also be an electrolyte. This by no means follows, and indeed experiments which have been made in this direction point to the contrary conclusion. The same holds good of his argument as to the combination of nitric oxide and oxygen—water *vapour* is not known to form a composite electrolyte with gaseous nitric acid.

With regard to the regularity displayed by iodine and hydrogen compared with the irregularity of the results obtained by Victor Meyer with chlorine and hydrogen, it is altogether impossible to understand Prof. Armstrong's attitude. In one sentence he assures us that "this is not surprising," and in the next that "there is a significant [of what?] difference in the behaviour of the two mixtures, as hydrogen iodide should behave as hydrogen chloride." He suggests that some special electrolyte may be active in the case of chlorine and hydrogen; but he is inclined to account for the difference observed from the fact that only one of the reactions is reversible under the conditions of experiment. We quite fail to understand the influence which the reversibility of the reaction would exert on its regularity.

In fine, still assuming for the sake of argument the notion of "reversed electrolysis," we would ask:—In a mixture of hydrogen and oxygen, are the ions there, or are they not there? If not there, will the presence of a *vapour* bring them into existence? If there, what is the need of a so-called impurity? Is it supposed that the impurity will discharge them? Why, then, does not the presence of one or of two conducting wires of the same metal in an electrolyte cause combination of the ions?

University College, London, July 8. W. RAMSAY.
JAMES WALKER.

The Corona Spectrum.

IN the preliminary account by M. Deslandres of the main results of the eclipse photographs obtained by the French astronomers at Fundium, as reported in this journal on May 25 (vol. xlviii. p. 81), it is stated that many new coronal lines have been photographed, and that a displacement of the lines in the light from opposite points of the corona in the solar equatorial plane proves a rotational movement nearly corresponding with that of the surface of the sun itself.

In the absence of fuller details it is perhaps a little difficult to accept without reserve these interesting statements, particularly when one considers the somewhat unfavourable conditions under which the photographs were obtained. In the first place, one would like to ask by what means have these new bright lines been identified as belonging to the corona, seeing that, owing to the hazy condition of the air at the above station, the brilliant chromospheric radiations were apparently reflected from a considerable area of the sky in the sun's neighbourhood, forming, as it were, a kind of false corona with a bright line spectrum. So obvious, indeed, is this atmospheric spreading of the chromosphere lines in the spectrum photographs obtained by the English astronomers at the same station, that many lines are shown as clearly on the moon's disk as in the coronal regions; the calcium lines "H" and "K," which are very brilliant chromosphere lines, are in these found to extend considerably above the limits of the true corona, as defined by its continuous spectrum, and are also found equally bright across the dark moon.

From the above considerations one is inclined almost to doubt whether, after all, any true corona lines have ever been proved to exist, excepting perhaps the line 1474 (K), which is not ordinarily a brilliant line in the chromosphere, and would therefore not be easily seen by atmospheric reflexion;[1] and it would seem possible, if not probable, that this beautiful solar appendage, with its dark rifts and curving streamers, shines simply by continuous light.

Definite information on this point would, however, be gladly welcomed by those who are endeavouring to photograph the corona without an eclipse. We would, in fact, clutch at any straw, in the shape of a bright line, in the hope of its yielding a true image of the coronal forms, and it was hoped that the recent eclipse would furnish evidence which would settle this question.

With regard to the second point, namely, the displacement of lines in the coronal spectrum. This is said to be equal to a velocity in the line of sight of 5 to 7 kilometres per second (I presume for the total difference of position of the line), say 3 kilometres for the speed of approach or recession at a distance from the solar limb equal to two-thirds of the diameter.

This is certainly a very striking result, and if confirmed by further study would in itself go far to prove the true coronal nature of the line measured. A displacement is conceivable, it is true, under certain conditions, on the assumption that the light is reflected chromospheric light, but this would not exceed a velocity of 1·87 kilometres, whilst the above result comes not far short of an angular rotation equal to that of the disk itself. A point at the distance named would, if rigidly connected with the sun, alternately approach and recede at a speed of about 4·35 kilometres per second.

It would be interesting to know, however, what are the limits of error in these measurements. I gather that a high dispersion was not employed, and it would seem, therefore, that a large uncertainty may be expected; supposing, for instance, that in the original negative the lines H and K are depicted 25 mm. apart, the total displacement corresponding to 7 kilometres per second will only amount to 09 mm.; an error, therefore, of $\frac{1}{50}$ mm., or $\frac{1}{1250}$ of an inch (corresponding to over 1½ kilometres) would materially affect the result; and to come within this limit would require unusually fine definition in the line measured.

In view of the novelty and great importance of the conclusions arrived at by the leader of the French eclipse expedition to Senegal, students of solar physics will await with keen interest, not to say impatience, the publication of a full detailed discussion of the results obtained. J. EVERSHED.

Kenley, Surrey, July 2.

Lord Coleridge and Vivisection.

MY attention has been called to a letter which the Lord Chief Justice has written in support of an endeavour which is being made by a section of the Society for Promoting Christian Knowledge to withdraw from circulation my little work "Our Secret Friends and Foes," recently published in their "Romance of Science Series." Until the Publication Committee of the

[1] It seems pretty certain, however, from the clearly-defined coronal "rings" seen by Prof. Lockyer and others at former eclipses by means of an objective prism, that a more or less uniform gaseous extension must exist far above the chromosphere and prominences; but is this the corona proper?

Society, in which I have every confidence, takes any action in this matter, I have no wish to participate in the controversy, and have but little doubt that the simple publication in your columns of the enclosed correspondence, without any comment from me, will be quite sufficient to enable the readers of NATURE to form a correct opinion as to the manner in which my book has been made to serve the purposes of the Victoria Street Anti-Vivisection Society.

PERCY F. FRANKLAND.

University College, Dundee, July 15.

"The committee of the Victoria Street Anti-Vivisection Society have issued the following protest to the members of the Society for the Promotion of Christian Knowledge against a work recently published by that Society, and concerning which the Lord Chief Justice has written the letter appended :—

20, *Victoria Street, London, S.W., July* 1893.

Sir (or Madam),—The attention of the Committee of the above society has lately been drawn to a book issued by the Society for Promoting Christian Knowledge entitled "Our Secret Friends and Foes," the author of which, Dr. Percy Faraday Frankland, held a license last year as a practical vivisector.

My committee consider that the following extracts sufficiently show that the book is calculated to encourage the unjustifiable and demoralising practice of experimenting on living animals :—

"Nicolaier was the first to discover that certain bacilli, widely distributed in the superficial layers of soil, were capable when subcutaneously inoculated into mice, guinea-pigs, and rabbits, of setting up symptons typical of tetanus from which they subsequently died." (Page 123.)

"Rabbits and guinea-pigs inoculated with some (spider's) web . . . . died under particularly well-defined symptoms of tetanus." (Page 126).

Again, with regard to the Pasteur methods, which, from their nature, must involve great torture of animals, we read :—

"Numerous investigators have succeeded in calling forth many of the symptoms of a disease by injecting the products of these organisms" (Page 140.)

On page 148 there is the following passage referring to the establishment of Pasteur Institutes :—

"Such institutions have been established in Russia, Hungary, Italy, Sicily, Brazil, Mexico, Turkey, the United States, and Roumania, whilst in Great Britain, to our unutterable disgrace, we are in this respect behind the unspeakable Turk, and the semi-barbarous subjects of the Czar."

That a Pasteur Institute has not yet been established in England, in spite of repeated efforts on the part of the vivisecting school, is greatly to the credit of this country, for such an institution would result in an enormous increase in the number of painful experiments on God's innocent creatures.

My committee are of opinion that the teaching of this book is opposed to the objects of the Society for Promoting Christian Knowledge, and I am directed earnestly to urge you, if you consider the objections to the book are valid, to write the Secretary, Editorial Department, S.P.C.K., Northumberland Avenue, London, W.C., and protest against the continued publication of it.—I am, Sir (or Madam), your obedient servant,

BENJN. BRYAN, Secretary.

The following is the letter from the Lord Chief Justice of England :—

1, *Sussex Square, W., June* 27.

Madam,—I have signed this paper, not exactly with pleasure, for the whole subject is utterly odious to me, but with great willingness. I have never seen any reason to change or qualify the opinions I expressed many years ago in an article on vivisection which your society reprinted. Should the book in question not be withdrawn by the Society for Promoting Christian Knowledge, I shall at once withdraw myself from it, as it will, in my judgment, become a Society for the Promotion of Unchristian Knowledge. Very good men, I am quite aware, take a different view, and will continue to support the society ; but a man, however obscure, must act upon his convictions, especially when they have not been hastily taken up and are not quite ignorantly maintained.—I am, Madam, your obedient servant (Signed) COLERIDGE. Miss Monro."

Oyster-Culture and Temperature.

IT may interest some of your readers to know that there has been an unusually heavy deposit of oyster spat just now on the collectors (tiles) along this west coast of France. Some of the tiles I have seen during the last few days have been very densely crowded over with the little amber-coloured scales. The oyster breeders both at Arcachon and at Point de Chapus, men of long experience, attribute the special abundance of the spat this season to the continuous hot weather.

The calmness of the sea at the time when the embryos were set free may also have had something to do with an unusually large number passing safely through the critical larval stages.

The temperature of the sea on various parts of the oyster "parcs" at Arcachon last Monday was from 80° to 90° F., and out in the open to-day, half-way between the islands of Oleron and Ré, I find it is 72° F. However, it may be hoped that although temperatures like these may be favourable, they are not necessary for successful oyster breeding.

W. A. HERDMAN.

St. Pierre Ile d'Oleron, France, July 7.

The Diffusion Photometer.

IN the discussion before the Physical Society of June 9, a photometer made of paraffin blocks is mentioned as "The Jolly Photometer." I think, however, that this is the photometer described by me in the *Philosophical Magazine* some two or three years ago ; also in the proceedings of the Royal Dublin Society, and exhibited before the British Association on the occasion of their meeting at Bath. I cannot now give exact references, but I must be pardoned for calling attention to the mistake, as it has been made before by a high authority, and seems likely to be perpetuated in England.

It is correctly described in Wiedemann and Ebert's "Physikalisches Praktikum," recently published (p. 217).

Bonn, July 12. J. JOLY.

P.S.—I have no objection to the prefix if written with a small letter.

[We followed the spelling of the word contained in the official report of the Physical Society.—ED.]

ALPHONSE DE CANDOLLE.

THOUGH this notice is somewhat belated, the passing away of a figure so conspicuous as De Candolle in the European world of science cannot be permitted to receive no more sympathetic notice than a bare record of the fact.

Alphonse Louis Pierre Pyramus de Candolle, to give him his full name, died on April 4 at his house in the Cour de St. Pierre at Geneva, in the eighty-seventh year of his age. If his bodily vigour had of late somewhat failed, he preserved his scientific interests and mental activity up to the last. Only the week before his death I received a letter from him, in which there was no indication of failing vitality, and in which he wrote without anxiety of the work that he had in hand.

So many of us have grown up under the shadow of De Candolle, that it seems almost a kind of impiety to sit down and coldly measure his stature. To me it seems that in a manner his death closes an epoch. With him passes away the last great representative of the French School of Botanical Taxonomy—to which, through Bentham, the English was in a great measure affiliated—and which had its root in Lamarck, whom the world in general scarcely realises as a botanist.

Geneva has long been remarkable as the home of a number of families whose members have cultivated science with distinction. These are for the most part descendants of French Protestants who have emigrated from the south of France. Amongst these the De Candolles stand out in pre-eminence ; the third generation still sees them in the front rank of the scientific world.

Alphonse de Candolle's father, Augustin Pyramus, was a man who would have been remarkable in any age. Gifted with astonishing energy and enthusiasm, a singular power of grasping and co-ordinating large masses of detail, and indefatigable industry, his buoyant charm of manner inspired even the citizens of Geneva with interest and conviction in the supreme importance of taxonomic studies.

I know nothing in scientific literature more entertaining and instructive than his *Mémoires* and *Souvenirs*. They supply a striking instance of his irresistible influence. The return of an important collection of original drawings of Mexican plants was demanded by the lender. De Candolle roused the whole of Genevan society to his aid; the city was almost in a ferment till by united co-operation every one of the 1200 drawings had been copied.

The facts to be told of Alphonse de Candolle's life are simple. Born October 27, 1806, at Paris, he took the degree of Bachelor of Science at Geneva in 1825, and of Doctor of Laws with great distinction in 1829. The influence of his legal training probably gave an impress to his work and character all through life. In 1831 he began to assist his father in his duties as Professor of Botany, and he succeeded him in the chair in 1835. He held it till 1850, when he left it, owing to political events. The remainder of his life he passed as a private man of science. But during middle life he fulfilled with dignity, and not without influence, the duties of a citizen which his character and social position in some sort imposed upon him. After serving as a member of the Representative Council of Geneva, he was a member of the Grand Council from 1862 to 1866. He was the first to advocate the "referendum" in political affairs; he exerted himself to effect numerous reforms in economic and sanitary matters; and by obtaining the use of postage-stamps for his Canton he appears to have paved the way for their general introduction into Switzerland.

The earliest and perhaps the best of De Candolle's botanical works is his Monograph of the *Campanulaceæ*, published in 1831. It has stood its ground more solidly than is often the case with the taxonomic work of the time, and its conclusions have been in the main adopted in the later revision of the order by Bentham and Hooker.

In 1841 De Candolle's father died. He had commenced the publication of the *Prodromus* in 1824. The object of this vast undertaking was to give brief diagnostic descriptions of all known plants. Its publication finally settled the question which had long agitated the scientific world as to the supersession of the artificial Linnean system by a natural one. What is called the Candollean sequence is still in general use, though it is confessedly in some respects itself artificial, and only an approximation to a truly natural arrangement. The father had published seven volumes of this classical and indispensable work. The son carried it down to the completion of the Dicotyledons in the seventeenth volume, published in 1873. He saw that no one man could carry out the task single-handed. While formulating a uniform plan and method of procedure, he managed to summon to his aid the systematic botanists of all Europe. In 1847 he was able to claim that he had contributors from England to the Tyrol, and from Montpellier to the Baltic. He took himself no mean share of the work, and if this kind of research affords comparatively little opportunity for the display of genius, Alphonse de Candolle's work is always characterised by qualities of workmanlike accuracy and scholarly finish.

In early life the writings of Humboldt inspired De Candolle, as they have done many young men, with the impulse to travel. Family circumstances, however, forbad it. But the fascination of phyto-geographical problems had taken possession of him, and the vast assemblage of specific forms which continually passed through his hands must have supplied him with inexhaustible food for reflection.

In 1855 appeared his *Géographie botanique raisonnée*, which was the most important work of his life. It would be impossible in a short space to appreciate this justly. It has been complained that it led to no direct conclusion; and it is all but inexplicable that the author missed seeing that the immense mass of facts he had collected really pointed directly to evolution as the key to its explanation. But the character of the man is an element which must not be overlooked. Essentially in method a statistician, he believed these facts, properly marshalled, would evolve their own law. But scientific method, like other calculating machines, will not evolve more than is implicitly put into it. De Candolle, it must be admitted, neither possessed nor had much sympathy with that touch of imagination akin to inspiration, which by some unconscious cerebral integration sees an even wider principle underlying the facts which are contemplated than by any method of manipulation can be educed from them. But it may be doubted whether a study of the Distribution problem would ever have led to evolution directly. The essence of the Darwinian theory was the discovery of a possible, at any rate conceivable, *modus operandi*. This was the result of an attack from the biological side. The phenomena on a large scale which geographical distribution present are too remote from their ultimate cause to immediately suggest it; yet when the principle is grasped they are immediately susceptible of deductive explanation.

Nevertheless, I cannot but regard the *Géographie*, if not as an actual precursor, yet as one of the inevitable foundation-stones of the modern evolution-principle. In the first place, De Candolle dealt more than one heavy blow to Lamarckism. Botanists were impregnated with the idea that plant-distribution was a mere matter of temperature. Adanson had supposed that there was a simple numerical relation between it and growth. Boussingault had gone further and stated that the product of the period of growth multiplied into the mean temperature was a constant. That within limits there is truth in these statements, I myself believe, and for cultural staples the problem is still worth fresh investigation. But the facts will not bear generalisation, and in the field of nature De Candolle saw that they explained little. Other factors, such as light and moisture, must also be taken into account; if he had gone a little further he would have met the "Struggle for Existence."

But De Candolle's most fertile conclusion was the derivative nature of existing floras, and he cites with approval the classical speculations of Edward Forbes on the flora of Western Europe. De Candolle at any rate brought together a mine of accurate information, collected with vast labour without prepossession and marshalled with consummate judgment. He has furnished an armoury from which it will be long before successive students of the subject cease to draw their weapons. Had he taken narrow and pedantic views of specific limitations, he would have left the subject more confused than he found it. But by treating, for example, the aquatic Ranunculi as a group of variable forms of a single species, *Ranunculus aquatilis*, he supplies facts in a shape at once available for the Darwinian student.

De Candolle met Darwin in 1839, and though he maintained a correspondence with him, they did not meet again till 1880, when the former paid a visit to town. Of this he published a touching and in some degree pathetic account in 1882. He makes his submission to the inevitable. I will translate a few words:—

"The existing distribution of species, especially in islands, compelled me to admit, as early as 1855, four years before the appearance of the "Origin of Species," the creation, in certain cases, of new specific forms derived from older ones. I proved to demonstration that the majority of species ascend to periods far more remote than is generally supposed, and that they have passed through both geological and climatic changes. Lyell accustomed geologists to consider small causes, operating through long periods, as competent to produce large effects. The astronomical conception of indefinite time had penetrated natural science. Five or six thousand years counted for little in the history of organised beings. . . . Uncertainty

was everywhere. The facts of classification, of palæontology, of geographical distribution, of organogeny ceased to be intelligible. It was necessary to tread through the barrier of a limited time, and of the belief in the permanence of specific forms. *Alors parut Darwin.*"

The influence of Darwin was conspicuously shown in the remarkable book which De Candolle published in 1873, under the title of "Histoire des Savants." He lays botany aside, and going back to the studies of his academic life, starts afresh under the inspiration of the new ideas. But he does this with the same reserve and almost sceptical spirit which characterises all his writings. The facts must evolve their own consequences He is reported to have said that "he was a botanist by inheritance and a statistician by birth." But he applies to the treatment of his data a statistical method which is positively fascinating in the skill with which it is employed, and the interest of the results to which it leads. I must content myself with a single conclusion, the undoubted validity of which, it seems to me, is often overlooked.

"Heredity neither gives scientific men special nor extraordinary powers; but only that combination of moral and intellectual qualities which may be directed according to circumstances and the choice of the individual to scientific study or to any other serious or definite object." If we slightly enlarge this conclusion by regarding extraordinary aptitude for particular branches of scientific discovery (or any other field of intellectual or artistic activity), as a sort of exceptional sport from an already specialised race, it appears to me that we have the whole root of the matter. A very distinguished man of science has been known to hazard the opinion that if he had turned his attention to law, he would probably have become Lord Chancellor. I think that he only erred on the side of modesty, and that he would equally likely have been Prime Minister.

But I must pass on. In 1880 De Candolle published his *Phytographie*. This is a useful book, indispensable to the taxonomic workshop. It elaborates and enforces the admirable principles of plant descriptive work laid down by Linnæus, which make the study one of no small value as an educational discipline. The book will always have its value as keeping alive an admirable tradition. Would that its example and precepts were more taken to heart by many modern botanists who fail to see that a description is one thing, a luminous and logical diagnosis a totally different one!

Finally, in 1883, De Candolle published his "Origine des Plantes Cultivées." This sprang from his prefatory studies for the *Géographie*. It is an altogether admirable book: not perfect certainly, or complete, and faulty perhaps more especially in the difficult matter of handling the philological evidence. Yet I know of no one who could have put together the material in a more masterly way, or who could have presented the conclusions derivable from it in a form more likely to carry conviction.

Here I must close. As I began by saying, a great figure has passed away. Distinguished in appearance, his manners though reserved, were always exquisitely urbane. If he lacked enthusiasm of a demonstrative sort he made up for it by extreme sobriety of judgment and inexorable persistence. He was singularly kind to all who were disposed to engage in botanical work; and would spare no pains to help and even aid, with his own accumulated materials, those who were willing to undertake a research. He died beloved by his family, revered by his countrymen, and loaded with distinctions. He was a Foreign Member of the Royal Society, a Gold Medallist of the Linnean Society, a D.C.L. of Oxford, and an LL.D. of Cambridge; and the possessor of the order which perhaps confers the greatest distinction on a scientific man, the "pour le mérite" of Prussia. W. T. THISELTON-DYER.

CARL SEMPER.

A GREAT investigator has left us, and one more vacant tablet of the Hall of Fame has received its inscription.

Carl Semper, born July 6, 1832, at Altona, near Hamburg, a son of the celebrated architect, Gottfried Semper, at first destined for the Royal Navy, but afterwards student, graduate, Privat-Docent, and for twenty-five years Professor of the University of Würzburg, has merited eminence as a traveller, a zoologist, a teacher, and an investigator.

The range of his "Thun und Schaffen"—his doing and making—is so wide that but scant justice can be paid to his labours within the short space of this article. As that of a travelled naturalist and the writer of important works of travel his name is honourably known to the geographer, while his investigations in pure zoology are among the most brilliant and weighty of the past thirty years.

Even in this field of science there was a many-sidedness about the observer, impelling him to work for the increase of knowledge in systematic zoology, comparative anatomy, embryology, comparative histology, and physiology.

His travels in the Philippine and Palau or Pelew Islands, for which he expended nearly the half of the large fortune inherited from his father, resulted in many valuable memoirs on various groups of invertebrata, the joint work of himself and others. Semper's "Holothuria," and his special studies of mollusca—a group in which he was a leading authority—may only be mentioned. His book on the "Palau-Inseln im Stillen Ocean" is unfortunately less known—at least, in this country—but in the opinion of good authorities there are few more delightful works of travel, and fewer still in which the observational powers of the naturalist find as full play.

Of Semper's molluscan work only a specialist can speak as it merits. I know not if he completed all that he intended to do, but I have a lively remembrance of the immense stores of material and drawings which he possessed ten years ago.

To experimental physiology he made many contributions in the *Existenz-bedingungen der Tiere* and elsewhere.

But the works of all others which established his reputation as a university professor were undoubtedly those on comparative embryology.

Among these, "Das Uro-genitalsystem der Plagiostomen" is preeminent. In this and other priceless memoirs was laid the solid foundation on which the ten volumes of the *Arbeiten aus dem Zoologisch-zootomischen Institut zu Würzburg* were gradually built up. The intensity and ardour with which he devoted himself to the problems of embryology also laid the beginnings of the long years of ill-health which have just closed with his death.

Though his work cannot be described as having escaped unscathed from the fierce embryological battles of recent years, most of it still stands intact, and is destined to remain, associated with the name of Semper, as part of the classic literature of vertebrate morphology.

With recapitulation embryology he had no sort of sympathy, and his polemics against Haeckel clearly defined his position as an opponent of the so-called "Law of Ontogeny." He was of those whose embryological work is based rather on the idea that organs, not organisms, repeat parts of their ancestral history in their development.

Of the departed master—"Der Chef," as his students affectionately termed him—a pupil cannot write without feeling. Long before his death the great number of his pupils, who had become occupants of University chairs,

testified to the success of his training. Profs. Ludwig (Bonn), Braun (Königsberg), Spengel (Giessen), Kennel (Dorpat), Kossmann (Heidelberg), Carrière (Strassburg), and Fraisse (Leipsic), and the Privat-Docenten Ludwig Will, Biehringer, Voigt, Schuberg, and others, still represent the old Würzburg Institute in more than half of the Universities of Germany. Pupils came to him from all parts of the world. Of his contemporaries only two, Albert von Kölliker and Rudolf Leuckart, can claim a longer array of scholars, and none have trained more successful investigators. Among those who pride themselves on their studies in the quaint old rooms overlooking the Neubaustrasse are R. S. Bergh, C. S. Minot, H. Jungersen, Sharp, Strubell, Goronowitch, Grassi, and the cousins Sarasin. From Great Britain came but two, the late Philip Carpenter and the writer.

The peculiarity of Semper's training consisted in this:—The budding zoologist was first thoroughly grounded in comparative anatomy and histology, and then only, after a preliminary trial on some well-worked theme, might he commence independent investigation. The work once begun, the student received abundant criticism but no help, and thus while Semper guided the worker, he never performed the task himself. In this way the memoirs of his pupils came to be not the work of a school in which the master alone was in evidence, but a series of papers dealing with widely divergent questions, and having only this in common that they were built on the same solid basis of elementary knowledge.

Semper was above all the close friend of his pupils, and with them he formed a small "Verein," in which he took considerable pride. The evenings—which usually became early mornings—spent in the little "Alt-deutsche Stube" of the "Zoological Garden" down the Main will not readily fade from recollection. Then it was that the conversation—French, German, and English—more frequently turned to zoological travel, and discussions on current zoology gave place to little lectures on the Philippines and Palau Islands, on Heligoland and the Riviera, on tropical animals and plants. The educational importance of travel to the young zoologist was an ever-recurring topic with Semper. The advice usually had good effect, for most of his pupils have at one time or another made zoological journeys to distant parts of the world—to Ceylon, to Trinidad, to Greenland, the Celebes, and other places.

One of Semper's ideals was a new laboratory with a tropical house for animals. After long treaty with the Government he was happy in obtaining the completion of his wishes—the new Zoological Institute, a building worthy of the architect-zoologist. Three short years ago we who were his old pupils rejoiced with him on the opening of the new abode. Now, as he would bid the fleeting moment stay, he is taken from us. The director's room is vacant, our chief and our "Studentenzeit" are alike memories, on both of which we can only dwell with fondness and affection. J. BEARD.

NOTES.

WE regret to record that M. Marié Davy died on July 16, at Clamecy, Nièvre, at the age of seventy-seven. M. Davy was at one time at the head of the physical-astronomy service of the Paris Observatory, and took a leading part in the protest against Le Verrier's administration in 1870. He published a large number of papers on electrical and astronomical subjects.

PROF. S. P. LANGLEY, Secretary of the Smithsonian Institution, announces that the Institution has secured a table at the Naples Zoological Station for the use of American investigators. The table will be known as the Smithsonian table. Publications resulting from its use will bear the name of the Smithsonian Institution, and such of them as are of sufficient importance will be printed in the "Smithsonian Contributions to Knowledge."

THE munificent gifts of the legatees of Sir Joseph Whitworth to Manchester are to be increased by a sum of £50,000. The amount previously given by them to carry out the scheme of the Whitworth Institute was £105,000. The legatees consider, however, that even their additional donation will need supplementing by the public if the institute is to attain its due importance.

THE International Maritime Congress commenced its second meeting on July 18 at the Institution of Civil Engineers, under the presidency of Lord Brassey. A large number of British and foreign representatives of maritime interests were present, and the outcome of the week's conference will doubtless be of considerable importance. Lord Brassey took for the text of his presidential address the construction and use of breakwaters, and the works that have been undertaken for the improvement of the entrances to ports. Mr. Mundella, M.P., followed with a description of the growth of the mercantile marine service of Great Britain. The Congress then divided into sections for the reading and discussion of papers. Lord Swansea presided over the section dealing with questions relating to the construction of harbours, breakwaters, and general sea-works; and Admiral Colomb is the president of the section devoted to signals, lights, and buoys. The papers read before these two sections were chiefly of a technical character.

AT the recent Congress of Archæological Societies a subject that elicited an interesting discussion was the "Continuation of the Archæological Survey of England." It was announced that the archæological maps of Essex, Lancashire, Cheshire, Surrey, Sussex, and Derbyshire had been considerably advanced since the meeting of last year. Maps are being prepared by societies in Herefordshire, Cumberland, and Westmoreland, on which all interesting antiquities are indicated. A series of symbols has been devised by the Standing Committee for the diagrammatic representation of antique objects and sites, and a resolution was passed expressing a hope that all societies participating in the survey will adopt these symbols and so ensure uniformity. Mr. H. S. Pearson, of the Birmingham and Midland Institute Archæological Society, gave a detailed description of a photographic survey of the county of Warwick. Each photographer who took part in the work was assigned a district of about six square miles, and their pictures were subjected to the criticism of a committee, in order to determine whether they were "worthy of acceptation." Up to now about 1,700 excellent photographs have been taken, and permanent prints of them have been well mounted and presented to the Birmingham Free Library, so that they could be referred to at any time. Mr. Pearson's paper was cordially received, Sir John Evans expressing his warm approval, and bidding all archæological societies throughout the country to "Go and do likewise." The Archæological Institute also held its annual meeting last week. There was a reception at the Guildhall, several excellent luncheons, with pleasurable and doubtless profitable excursions, and a *conversazione* at the Mansion House, so the meeting was a decided success, though no papers were read or discussion raised of scientific moment.

AT the annual meeting of the Wilts Archæological Society, to be held at Warminster on July 25 and two following days, the President, General Pitt-Rivers, F.R.S., will give an account of some excavations he has been recently making in an early camp in Cranborne Chase, near Rushmore, Salisbury, and adjacent to the group of tumuli of the Bronze Age, which were investigated by him in 1880 in conjunction with the late Prof.

Rolleston. The address will be illustrated by plans and sections, and two models will be exhibited showing the entrenchment before and after excavation.

A NUMBER of water-colour drawings, executed by the artists of the Archæological Survey of Egypt, are being exhibited at the residence of the Marquis of Bute, K.T., 83, Eccleston Square, S.W., and will remain on view until Saturday next. The collection of drawings comprise sketches by Mr. Percy Buckman of various sites of historical interest in the provinces of Minich and Assint, a large number of facsimile drawings of wall paintings in tombs of the ancient and middle kingdoms in the same province by Mr. Buckman, Mr. Blackven, and Mr. Howard Carter, as well as many architectural drawings from the tombs by Mr. John Newberry. Cards for admission to the exhibition may be had on application at the offices of the Egypt Exploration Fund, 37, Great Russell Street, W.C.

THE new laboratories at Guy's Hospital were opened on July 17 by Sir John Lubbock, Bart., M.P., F.R.S., a number of men of science being present. In the course of his remarks Sir John Lubbock said that great and brilliant as had been the discoveries in science during the last fifty years, that of the next would be grander still. He based his belief on three grounds. First, because while knowledge was finite science was infinite; secondly, because new processes and inventions were constantly being applied to research; thirdly, the number of investigators was greater and would go on increasing. He hoped that in the laboratories opened that day new steps would be taken in the triumphal progress of science. Sir John Lubbock subsequently presented the scholarships, medals, and prizes, to the successful students, and delivered an interesting address in which he pointed out the necessity of administering kindly advice and sympathy "to a mind diseased" as well as medicine to the body.

MR. R. LYDEKKER is about to visit the museums of Buenos Ayres and La Plata in order to examine the collections of fossil mammals and birds, a grant for that purpose having been made to him by the Royal Society.

THE Japanese section of the Cornwall Counties Fisheries Exhibition, shortly to be held at Truro, is being organised by a committee of the Council of the Japan Society, and promises to be attractive and interesting. Numerous exhibits, illustrating the fisheries of Japan, are now on their way to England, and many collectors of Japanese works of art have promised to lend objects representing fish and fishing.

THE British Consul at Porto Rico has reported to the Foreign Office that it is proposed to hold an exhibition in that city in November next to commemorate the four hundredth anniversary of the discovery of the island of Porto Rico. The exhibits will include agricultural and industrial implements and machinery, and other objects that are or may become articles of commerce. Space will be granted to exhibitors free of charge, and must be applied for by September 1. All exhibits will be admitted free of customs duty.

FROM September 3rd to 6th a meeting will be held at Lausanne in connection with the Société Helvétique des Sciences Naturelles. There will be a general assembly of the Swiss geological, botanical, and entomological societies, and also various geological and zoological excursions. A detailed programme of the excursions can be had on application to one of the Secretaries, Prof. E. Bugnion, or M. A. Nicati, Lausanne.

THE *Société de Topographie de France* intend to erect a statue of Cassini, the author of the first topographical map of France, in the town of Clermont-en-Beauvais (Oise), not far from Thury. It is a remarkable fact that the family of Cassini had, in a century and a half, five representatives as Members of the Academy of Sciences, of which four were directors of Paris Observatory, the third of them—César François Cassini, of Thury (1714–1784),—being the one whose memory will be honoured.

A REUTER'S telegram reports that the steamer *Falcon*, with Lieut. Peary and the members of the American Polar Expedition, sailed on July 15 from St. John's, Newfoundland, for Bowden Bay, the autumn quarters of the expedition.

THE arrangements are now completed for the celebration of the jubilee of the Rothamsted agricultural experiments at the Laboratory, Harpenden-common, on Saturday, the 29th inst., at 3 p.m., under the presidency of Mr. Herbert Gardner, M.P., President of the Board of Agriculture. The proceedings will commence with the dedication by Mr. Gardner of a granite memorial, erected in front of the Rothamsted Laboratory, to commemorate the occasion. Addresses of congratulation will then be presented to Sir John Lawes and Dr. Gilbert on behalf of the subscribers to the Rothamsted Jubilee Fund and various learned societies, including the Royal, Royal Agricultural, Chemical, Linnean, and other leading scientific institutions. Sir John Lawes will also be presented with his portrait, which has been painted by Mr. Hubert Herkomer, R.A., for the subscribers to the Jubilee Fund. Afterwards there will be a reception at Rothamsted by Lady Lawes. The Rothamsted Laboratory, where the ceremony will take place, adjoins Harpenden-common, and is distant about half a mile from the Harpenden station of the Midland Railway Company.

IT is reported that disastrous floods and landslips, caused by heavy rains and cloudbursts, have occurred in Tyrol, the principal scene of destruction being the upper and lower Inn Valleys, the Oetzthal, and the Zillerthal. Many houses have been swept away, together with the inhabitants and their cattle, while others have been buried by landslips.

SOME very heavy falls of rain occurred in the southern part of England on Saturday and Sunday last, owing to the passage of a small and shallow cyclonic disturbance, which travelled quickly to the eastward. The amounts recorded in several localities exceeded an inch within twenty-four hours, while at Eastbourne the fall was from two to three inches, or more than the average amount for the month of July. The accumulation of water at the latter place was due to the intensity of the fall during a short period; the amount recorded during the whole day has frequently been exceeded at other places.

IN a recent number of the new Russian journal (*Archives des Sciences Biologiques publiés par l'Institut Impérial de Médecine Expérimentale à St. Pétersbourg*, vol. i. no. 5) an account is given of the latest endeavours to secure protection against glanders. It would appear from the experiments here recorded that as a means of diagnosing glanders the "malléine" (extracted from cultures of the glanders bacillus) is of great value. On being inoculated into horses suspected of having glanders, and into healthy animals or horses suffering from some other disease respectively, the different effect produced was constant and very clearly defined. In the case of the former, the existence of glanders was indicated by a distinct rise in temperature, from 1°·5 to 3° C., and the formation of a tumour, whilst in the latter the temperature did not rise, or only very slightly, and an insignificant tumour, or none at all, was produced at the place of inoculation. Innumerable experiments on horses by various investigators confirm these results, and as a proof of the importance which is attached to these researches, it may be men-

tioned that only last September a circular was addressed by the German Government to the commanders of cavalry, ordering the injection of "malléine" into the horses of those regiments where cases of glanders were proved to have occurred.

THE fact that some micro-organisms may stimulate or depress the vitality or virulence of others has been taken advantage of by both Sanarelli and Chantemesse and Widal in their recent researches on immunity and typhoid fever (*Annales de l'Institut Pasteur*, 1892). The typhoid bacillus very rapidly loses its pathogenic properties when cultivated for any length of time outside the living body. Its virulence may, however, be revived by introducing it into an animal along with sterilised cultures of some special organisms. Sanarelli used sterilised cultures of the *B. coli communis*, beginning with 10-12 cc., and gradually diminishing the dose, until the typhoid bacillus, as taken from the last animal, proved virulent without any addition. Sterilised cultures of the *Proteus vulgaris* may, according to Sanarelli, be also used. Chantemesse and Widal obtained the same results by employing sterilised cultures of the *Streptococcus pyogenes*, it having been found by Vincent that in the most serious cases of typhoid fever which he examined the latter was present along with the typhoid bacillus.

THE true origin of contrast colours is still a much-debated question among physicists. The Young-Helmholtz hypothesis of colour sensation assumes that the perception of a contrast colour by which, for instance, a shadow cast by a candle in daylight appears blue, is due to an error of judgment brought about by falsely taking the candle as representing white light and "dividing the difference of tint between the various portions of the surface equally between them." Mr. Alfred M. Mayer, in the *American Journal of Science*, attempts to show by a series of experiments that the perception of contrast-colour is due to purely physiological, and not to psychical causes. Some careful chronograph experiments showed that the perception of a contrast colour did certainly not require more than one-fifteenth of a second. A spark from a Holtz machine, lasting a millionth of a second and 8cm. long, made a grey ring on an emerald green ground appear a bright pink. The spark was also passed between brass knobs placed in front of a piece of silvered mirror half covered with a piece of green glass. The path of the spark presented a remarkable appearance. The portion reflected from the mirror only was white, while the other portion consisted of two images reflected by the green glass and the mirror respectively. The former appeared red by contrast, and the latter was coloured green by transmission through the glass. Thus a white source appeared both white and red at the same instant. The hypothesis of a knowledge of the real whiteness of the surface illuminated partly by a candle and partly by daylight influencing the perception of contrast colours was refuted by arranging such a surface behind a screen and letting two independent observers view it through a tube showing two semi-circles in juxtaposition. They were misled as to what to expect, but they both immediately described the patches as yellow and sky-blue respectively. These experiments tend to confirm Hering's hypothesis, which assumes that when a portion of the retina is stimulated, adjoining portions are affected by a sort of inductive action producing complementary perceptions.

AN interesting note on the variation of the earth's magnetism in the neighbourhood of a hill containing magnetic rocks, by Messrs. Oddone and Franchi, has appeared in the *Annali dell' Ufficio Centrale di Meteorologia e Geodinamica* (vol. xii. part 1). The hill was composed of serpentine, and had, roughly speaking, a lenticular shape, being 1500 m. long and 500 m. broad, with its greatest length north-west and south-east. The declination is the only element up to now observed, and the variation of this element along certain lines has been determined by means of a large compass, to which a telescope, moving in a vertical plane, was attached. The needle, about 16 c.m. long, had a fine pointer attached, and its position was read by means of a scale engraved on looking-glass. A preliminary series of observations, made on ground where there was no disturbance, showed that this instrument could be depended on to within one or two minutes of arc. The method of observing followed was to set up the instrument, and, looking through the telescope, note a series of points, all in a straight line with some distant object, then to clamp the horizontal scale to the telescope support, and read the ends of the needle. The instrument was then transported to the points which had been noted, and the telescope directed to the distant mark. Then the differences in the readings for the needle gave the differences in the declination at the stations along the line. As an example of the magnitude of the deviations obtained we may give the following set of readings (corrected for diurnal variation), along a line running north-east from the hill. At the out-crop of the serpentine the reading for the needle was 11° 20′; about 100 m. away, 10° 35′; about 500 m. away 9° 56′ 30″; while at a distance of 700 m. it was 9° 50′ 30′. In every case they obtained an attraction of the north pointing pole of the needle towards the serpentine, thus indicating that the mass of rock was magnetised with its upper end a south pole.

M. FÉLIX LECONTE has invented a simple form of automatic cut-out, consisting of a cylindrical metal vessel containing mercury and closed at the bottom by a plate of iron held up by springs. A copper rod dips into the mercury and forms one terminal, the current passing through the mercury to the metal cylinder, which forms the other terminal. Beneath the piece of iron an electro-magnet is placed, which is connected with an electric battery, whose circuit is closed at any pre-arranged time by a contact fixed to a clock. When this contact is made, the electro-magnet attracts the iron, allows the mercury to escape, and thus breaks the main current.

A MEMOIR on prehistoric naval architecture of the north of Europe, by Mr. George H. Boehmer, has been issued by the U.S. National Museum. 'Tis "a tale of the times of old," and therefore full of interest to the student of history. Furthermore, it is written with technical knowledge, and bristles with references, and therefore commands the respect of the scientifically-cultured mind. In the memoir the build of thirty ships, discovered in various places, is explained by text and illustration. And the whole discussion indicates that the maritime explorations of the people of the south, the Phœnicians, influenced the character of the naval structures of the ancient inhabitants of Scandinavia. Of all the boats that have been excavated none seem to excel in beauty that found at Gokstad, Norway, in 1880, and now in the Archæological Museum of the Royal Frederichs University at Christiania. In the opinion of experts this boat is a masterpiece of its kind, not to be surpassed by aught which the shipbuilding craft of the present age could produce.

WE have received the first number of *The Physical Review*, a journal of experimental and theoretical physics conducted by Mr. G. L. Nichols and Mr. E. Merritt, and published for Cornell University by Messrs. Macmillan and Co. The new publication is on much the same lines as the *Philosophical Magazine*. It contains five papers on physical subjects, a few notes, and critical articles on several new books. Mr. Nichols writes on the transmission spectra of certain substances in the infra-red, and Mr. B. W. Snow on the infra-red spectra of the alkalies. The relation between the lengths of the yard and the metre form the subject of a paper by Mr. W. A. Rogers. Messrs. S. Sheldon and G. M. Downing write on the critical current

density of copper deposition, and the absolute velocity of migration of the copper ions, and Messrs. F. Bedell and A. C. Crehore give a geometrical proof of the three-ammeter method of measuring power. We wish the venture the complete success that its high character merits.

WE have received a copy of "The Brighton Life Table," based upon the mortality of the ten years 1881–90, by Dr. Arthur Newsholme. No previous life-table has been constructed for Brighton, so the vital statistics of 1881-90 could not be compared with those of any preceding decennium. Dr. Newsholme has, however, compared his figures with those for the whole of England and Wales between 1871 and 1880, and also with the 1881–90 life-table of Manchester. The comparison indicates that the probabilities of life among both males and females are at most ages greater in Brighton than elsewhere —a result that might have been expected.

WE learn from the *Victorian Naturalist* that Mr. D. M'Alpine, pathologist to the Victorian Department of Agriculture, is preparing for publication by the Department a *Systematic Census of Australian Fungi*, together with a host-index and list of works on the subject. He is desirous of making the list as complete as possible, and will be pleased to receive from workers any published papers, &c., especially on the microscopic forms. It is proposed to continue the list in annual supplements.

THE 1892 report of the Superintendent of the Royal Botanic Gardens, Trinidad, has been received. The experiments instituted by the Government having shown that tobacco of a suitable character for making good cigars can be grown in Trinidad, enterprising planters are beginning to cultivate a sufficient area to make the crop remunerative. Mr. Hart reports that the quality of the product of the district (always a tobacco producing one) in which the operations were conducted, has much improved. The native cultivators have partially adopted the methods employed by the skilled cultivator, hence it is anticipated that the industry will continue to make progress during future years.

MR. M. DUNN, of Trevagissey, has sent us a paper by him on "The Migrations and Habits of the Pilchard," which appears in the annual report of the Royal Polytechnic Society for 1892.

MESSRS. LONGMAN will shortly publish a work entitled and specially devoted to "The Micro-organisms in Water," by Prof. and Mrs. Percy Frankland. It will deal not only with the presence and significance of bacteria in water, but also with the various means of effecting their removal, and an account will be given of what is known concerning the vitality of pathogenic microbes in various waters. A tabulated description of the micro- and macroscopic characters of all the micro-organisms, both pathogenic and non-pathogenic, hitherto discovered in water will be appended, whilst a special part will be devoted to the methods involved in the bacteriological examination of water. The work is intended to serve as a handbook for all interested in the sanitary aspects of water supply.

A CATALOGUE of books issued by Mr. Charles Lowe, New-street, Birmingham, contains the titles and descriptions of a number of scientific works for sale and wanted.

A CONSIDERABLE number of metallic salts of sulpho-phosphoric acid, H_3PS_4, have been obtained in a pure state by Dr. Glatzel of Breslau, and are described in the current number of the *Zeitschrift für Anorganische Chemie*. They are prepared by heating an anhydrous mixture of the chloride or sulphide of the metal with phosphorus pentasulphide, being produced in accordance with the equations :—

$$3RCl + P_2S_5 = R_3PS_4 + PSCl_3,$$
$$3R_2S + P_2S_5 = 2R_3PS_4.$$

The metallic chloride or sulphide requires to be perfectly dry, if possible being fused previous to the experiment. When cold it is finely powdered, intimately mixed with excess of anhydrous pentasulphide of phosphorus and the mixture heated in a small retort, at first slowly and carefully, finally to low redness. If the chloride of the metal is employed, thiophosphoryl chloride distils over and is condensed in a receiver. The excess of phosphorus pentasulphide sublimes into the neck of the retort, leaving the metallic sulphophosphate behind. The latter is purified from any undecomposed metallic chloride or sulphide by washing first with dilute hydrochloric acid, and afterwards with water, filtering and drying. In this manner the normal sulphophosphates of manganese, zinc, ferrous iron, nickel, cadmium, lead, thallium, tin, copper, silver, mercury, bismuth, antimony and arsenic have been obtained in a pure state. In addition to these, normal potassium sulphophosphate K_3PS_4 has also been obtained, but it was found impossible to separate it entirely from phosphorus pentasulphide ; efforts to prepare normal sulphophosphates of sodium, ammonium, barium, strontium and calcium have not yet been successful. The normal sulphophosphates of manganese, zinc, ferrous iron, nickel, cadmium and copper were obtained in the form of crystalline powders, the others as fusible solids, which crystallise upon re-solidification. The zinc and cadmium salts are white, the manganese salt green, the iron, nickel, lead, tin and bismuth salts vary from dark brown or grey to black ; the thallium, copper, silver, antimony and arsenic salts are yellow ; and mercury sulphophosphate is red and very sensitive to light. The whole of them, with the exception of the potassium salt, are insoluble in water and organic solvents, but are slowly attacked by dilute acids with evolution of sulphuretted hydrogen. The potassium salt is decomposed by water alone with liberation of the same gas. It would appear, indeed, that the more negative metals, such as bismuth, antimony and arsenic form sulphophosphates with the greatest facility. The bismuth salt $BiPS_4$ remains in the retort after distilling a mixture of bismuth chloride and phosphorus pentasulphide as a dark-coloured liquid which solidifies to a grey mass upon cooling, and yields upon pulverisation a powder of the colour of red phosphorus. Antimony and arsenic form similar crystalline sulphophosphates of a yellow colour, which are more volatile, however, and, moreover, may be distilled without decomposition. The arsenic salt solidifies in the receiver in a transparent form resembling amber.

IN attempting to prepare a ferric sulphophosphate by the action of phosphorus pentasulphide upon anhydrous ferric chloride, an unexpected artificial synthesis of iron pyrites, FeS_2, in crystals identical with those found in nature, was effected. The reaction occurs as represented by the equation :—

$$3Fe_2Cl_6 + 2P_2S_5 = 3FeCl_2 + 3FeS_2 + 4PSCl_3.$$

The crystals of iron pyrites were formed as a beautiful glistening sublimate just above the heated portion of the retort. They possessed the usual brass-yellow colour and brilliant lustre, and consisted of pentagonal dodecahedrons and cubes or combinations of these forms, together with faces of the octahedron and of the more complicated forms of the cubic system. Moreover, the same mode of striation was observed as is so characteristic of natural crystals.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include the Polychæta *Stauroccphalus rubrovit-*

tatus and *Sphærodorum peripatus*, the Isopod *Apseudes Latreillii*, the Schizopoda *Mysidopsis gibbosa* and *Hemimysis Lamornæ*, specimens of the Brachyuran *Hyas coarctatus* decked with weeds and compound Ascidians, the Lamellibranch *Arca tetragona*, and the Ascidian *Perophora Listeri*. In the floating fauna little change has been observed, but numbers of the Leptomedusan *Laodice cruciata* have been taken on the beds of Zostera. The following animals are now breeding:—The Hydroid *Coryne vaginata*, the Polychæte *Polycirrus aurantiacus*, the Amphipod *Corophium Bonellii*, the Decapod *Palæmon squilla* and the Lamellibranch *Arca tetragona*.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*, ♀) from India, presented by Capt. R. D. Arnold; a Leopard (*Felis pardus*), a Striped Hyæna (*Hyæna striata*) from India, presented by Capt. Currie; a Malayan Bear (*Ursus malayanus*) from Malacca, presented by Mr. M. O. N. Rees-Webbe; four Prairie Marmots (*Cynomys ludovicianus*) from Texas, four Orbicular Horned Lizards (*Phrynosoma orbiculare*) from California, presented by Mr. G. B. Coleman; a Harnessed Antelope (*Tragelaphus scriptus*, ♂) from West Africa, presented by Mr. A. L. Jones; four Galapagan Doves (*Zenaida galapagensis*) from the Galapagos Islands, an Auriculated Dove (*Zenaida auriculata*) from Chili, presented by Capt. Hedworth Lambton, R.N.; a Guilding's Amazon (*Chrysotis guildingi*) from St. Vincent, W.I., three Boddaert's Snakes (*Coluber boddaerti*), three Carinated Snakes (*Herpetodryas carinatus*) from Grenada, W.I., presented by the Hon. Sir Walter F. Hely-Hutchinson, K.C.M.G.; two Red-tailed Buzzards (*Buteo borealis*) from Jamaica, presented by Mr. Charles B. Taylor; a Crested Porcupine (*Hystrix cristatus*) from Africa, an Australian Cassowary (*Casuarius australis*) from Australia, two Blyth's Tragopans (*Ceriornis blythi*, ♂ ♀) from Upper Assam, deposited; two African Tantalus (*Pseudotantalus ibis*) from West Africa, two Demoiselle Cranes (*Grus virgo*), six Moorish Tortoises (*Testudo mauritanica*) from North Africa, a Secretary Vulture (*Serpentarius reptilivorus*) from South Africa, two Common Rheas (*Rhea americana*, ♂ ♀) from South America, two Cabot's Tragopans (*Ceriornis caboti*, ♂ =) from China, four Crested Pigeons (*Ocyphaps lophotes*) from Australia, purchased; a Mule Deer (*Cariacus macrotis*, ♂), a Martineta Tinamou (*Calodromas elegans*), seven Summer Ducks (*Æx sponsa*), seven Mandarin Ducks (*Æx galericulata*), three Australian Wild Ducks (*Anas superciliosa*), six Magellanic Geese (*Bernicla magellanica*), three Peacock Pheasants (*Polyplectron chinquis*), three Cheer Pheasants (*Phasianus wallichii*), six Gold Pheasants (*Thaumalea picta*) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS OF THE NEW COMET.—Prof. E. Lamp gives the following elements for Quénisset's comet in *Astr. Nach.*, No. 3173:—

τ = 1893 July 7·3140, Berlin Mean Time.

ω = 47° 6′·72
Ω = 337 20·93 } 1893·0
i = 160 1·88
log q = 9·82948

From these elements the following ephemeris has been computed by Dr. Kreutz:—

1893		R.A. app. h. m. s.		Decl. app. ° ′
July 21	...	11 27 28	...	+25 19·1
22	...	11 32 44	...	24 1·0
23	...	11 37 19	...	22 49·8
27	...	11 50 50	...	18 59·8
31	...	11 59 24	...	16 12·8
Aug. 4	...	12 5 18	...	14 6·2

The comet is decreasing in brightness.

The following communication has been received from South Kensington:—

"The comet was observed by Mr. Shackleton as early as July 11, before any notice of it had been received, but owing to the unfavourable state of the sky he was unable to perfectly satisfy himself that it was a new object. Although the sky was partially clear on July 14, the comet could not be seen from the Observatory as it was unfortunately very low in the north-west, and fell within the glare of the illuminations of the Imperial Institute. On Sunday, July 16, the sky was much clearer, and the comet was easily picked up with a small telescope. Observations with the equatorial, however, were impossible. Its position was roughly estimated as R.A. 10h. 41m., Decl. 33° N., and it was about equal in brightness to a fourth magnitude star. On July 17 the sky was clear, and the comet was observed by Mr. Shackleton with a 6-inch telescope temporarily erected in an elevated position; a faint tail was then observed, extending further on the southern than on the northern side of the axis. Owing to the absence of an equatorial mounting to the telescope employed, spectroscopic observations were very difficult, but three bright bands—probably the well-known bands of carbon which so frequently appear in cometary spectra—were recognised. There was only a very feeble continuous spectrum."

COMET FINLAY (1886 VII.).—The ephemeris of this comet for the ensuing week is as follows:—

1893.		12h. *Paris. M.T.* R.A. (app.) h. m. s.		Decl. (app.) ° ′ ″
July 20	...	4 30 54·16	...	+20 33 51·0
21	...	35 18·76	...	20 45 55·3
22	...	39 41·86	...	20 57 28·5
23	...	44 3·43	...	21 8 31·0
24	...	48 23·42	...	21 19 3·0
25	...	52 41·80	...	21 29 4·9
26	...	4 56 58·53	...	21 38 37·0
27	...	5 1 13·57	...	21 47 39·8

OBSERVATIONS OF THE PLANET VICTORIA.—Observations of this planet were specially undertaken in 1889 to determine the mean horizontal parallax of the sun, and afterwards to compare the calculated with the observed places of the planet with the object of proving the existence of a short periodic perturbation, as would occur if, for example, an erroneous value for the lunar equation had been adopted. The observations (*Bulletin Astronomique*, tome x., June 1893) were of three kinds, as Dr. Gill in this note informs us—(1) meridian observations of the planet and comparison stars, made at twenty-one observatories during the opposition in 1889; (2) heliometric triangulation of comparison stars, consisting of measures of the distances of the stars less than 2° apart and measures of the angles of position (these observations were made at the observatories of Yale College, Göttingen, Bamberg, and at the Cape during the year 1890); and (3) heliometric observations of the angular distance of the planet from two comparison stars, one above and the other below the apparent position of the planet in the sky. This work was accomplished by the same observatories with the addition of that at Leipzig.

In this preliminary note, Dr. Gill refers only to the general results of the discussion. The following table shows the values for the mean horizontal parallax of the sun as deduced from the discussion of the observations in groups:—

Group.	Limit of groups.	M.S. parallax.	Rel. weight.	$\Delta\alpha$ C−O.	$\Delta\delta$ C−O.
		″		″	″
I. ...	June 10–12	... 8·723	... 0·8	... —	... —
II. ...	,, 15–19	... 804	... 12·3	... −0·01	... +0·00
III. ...	,, 19–26	... 828	... 15·4	... +0·04	... +0·02
IV. ...	,, 26–July 3	... 872	... 29·2	... −0·02	... −0·07
V. ...	July 3–9	... 789	... 9·8	... −0·13	... +0·03
VI. ...	,, 9–12	... 857	... 17·5	... +0·09	... +0·04
VII. ...	,, 15–20	... 793	... 19·5	... +0·07	... +0·12
VIII. ...	,, 20–23	... 809	... 20·0	... −0·05	... +0·09
IX. ...	,, 23–25	... 742	... 14·0	... −0·03	... −0·03
X. ...	,, 25–28	... 806	... 11·2	... −0·07	... +0·02
XI. ...	,, 28–Aug. 4	... 777	... 33·4	... +0·01	... −0·12
XII. ...	Aug. 4–10	... 826	... 20·0	... +0·11	... −0·04
XIII. ...	,, 10–17	... 816	... 26·0	... −0·05	... 0·00
XIV. ...	,, 17–22	... 819	... 19·9	... +0·04	... +0·06
XV. ...	,, 22–27	... 8·738	... 13·3	... −0·04	... +0·01

The mean of these gives the value

π = 8″·809, with a probable error of ± 0″·0066.

The observed and calculated positions agree only in the limits of the errors of observations on the assumption "of a periodic term, the period of which is nearly identical with that of the lunar period, and whose maxima and minima occur at epochs when the longitude of the moon differs by 90° from that of the planet. Adopting 6″·40 in place of 6″·50 for the lunar equation, the residuals obtained from the corrected ephemeris and the observations are made very small, as can be seen from the last two columns of the above table.

The correction of −0″·1 in the lunar equation demonstrates, as Dr. Gill says, that the value adopted up to the present for the lunar mass ought to be diminished by one-hundredth.

DIFFERENCE OF LONGITUDE BETWEEN VIENNA AND GREENWICH.—In the fourth volume of the "Publicationem für die Internationale Erdmessung," entitled "Astronomische Arbeiten des k.k. Gradmessungs-Bureau," by Theodor v. Oppolzer, and after his death by Prof. Weiss and Dr. Robert Schram, we are presented with the results of the determination of the difference of longitude between Vienna and Greenwich, and with the Berlin time determinations and the personal equations of the separate observers relating to other longitude determinations, those between Vienna—Berlin—München—Greenwich. We may mention here that, with regard to the first-mentioned determination, another one, between the same places but after a method due to Döllen, by observations in the vertical of Polaris, will appear in a later volume.

The observations for the combined longitude determination between the above-mentioned places were commenced on July 7, 1876, and were completed on September 26 of the same year. Not only was the usual method of procedure adopted, but also that which we owe to Döllen, the instruments used being, for the former method those by Repsold, and for the latter those by Herbst. In the Vienna—Greenwich longitude determination at the beginning and at the end of the observations, time signals, both from Vienna and from Greenwich, were changed with Berlin; in the middle observations Vienna —Greenwich interchanged time signals; and towards the end München was included. In the following table, which gives the results for the single evenings, ΔL represents the longitude between the points of observation and $d\Delta L$ the deviations from the most probable value of the longitude difference :—

Date.	ΔL.	$d\Delta L$.
	h. m. s.	s.
17 July, 1876 ...	1 5 21·037 ...	+0·043
21 ,, ...	21·028 ..	+0·034
22 ,, ...	20·995 ...	+0·001
26 ,, ...	20·955 ...	−0·039
5 Aug. ...	20·832 ...	−0·162
7 ,, ...	21·107 ...	+0·113
17 ,, ...	21·146 ...	+0·152
21 ,, ...	20·845 ...	−0·149
27 ,, ...	21·016 ...	+0·022
5 Sept. ...	21·037 ...	+0·043
11 ,, ...	21·025 ...	+0·031
21 ,, ...	1 5 20·902 ...	−0·092

The result obtained, when the points of observations are reduced respectively to the centre of the Greenwich Transit Circle and to the centre of the large dome of the Vienna Observatory is

1h. 5m. 21·421s. ± 0·021s.

PHOTOGRAPHS OF THE MILKY WAY.—Prof. E. E. Barnard, who has recently been on a visit to Europe, has brought with him some wonderful photographs of the Milky Way, which are simply a revelation to many of us. These photographs (*The Observatory*, No. 203) were taken at the Lick Observatory with a lens made by Mr. Willard of New York in 1859, which is one of large aperture (6 inches) and short focus (31 inches). Such a lens tends to compress as well as intensify the characteristic features of these stellar clouds, the large field allowing one to embrace any of these forms as a whole, and not in detail, as is the case when they are viewed with a telescope. The first photographs, showing the cloud forms, were taken in August of 1890, the portion of the sky being that situated in Sagittarius, and the exposure 3h. 15m. A most interesting picture is that of a section of the constellation of Cygnus, near γ Cygni; this photograph shows some of those curious and almost weird dark spots and dark lanes the origins of which are very doubtful. Mr. Ranyard supposes them to be due to an obscuring medium between us and that part of the Milky Way, but Prof. Barnard's opinion is that they are real holes in the cloud structures themselves. Two photographs with different lengths of exposures (2h. 45m. and 4h. 30m.) of the region about M. 11 in the constellation of Sobeski raises an important point as regards the different structure of the Milky Way. The second picture exhibits details which considerably altered the configuration, not at all brought out in the first one. Not only in these photographs, but in several others of the Milky Way, this fact has been noticed, and Prof. Barnard suggests that there may be different orders or kinds of cloud structure implying distance or nearness, or possibly an entirely different order of stars in point of actual size.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE summer meeting of the Institution of Naval Architects was held last week in Cardiff. This is only the fifth provincial meeting held by this Society since its foundation. The first was in Glasgow, the next in Liverpool, and the third in Newcastle. The fourth was held again in Glasgow. All these meetings were eminently successful, and it is somewat strange that the Council should not have made a point of holding a country meeting every year. We believe, however, that it is now the intention to follow that course, and certainly the great success of the meeting held in South Wales last week will support those who advocate two meetings a year.

We propose in our report dealing only with the sittings held for the reading and discussion of papers, but it may be stated that the excursions were very successful. Some of these were of a purely recreative nature, such for instance as that which occupied the whole of the last day, Friday, the 14th inst., when members were taken from Cardiff to Ilfracombe and back by the steamer *Lorna Doone*. The visit to Caerphilly Castle, with the luncheon in the ancient banqueting hall, could not by any means be construed as "business" for naval architects, and the same might be said of the visit to Lord Windsor's grounds at Penarth, illuminated for the occasion.

Mixed with these junkettings, however, there was a good deal of a more serious nature, as the following list of papers read will show :—

(1) "On points of interest in the construction and repair of vessels carrying oil in bulk," by B. Martell, chief-surveyor of Lloyd's Registry of Shipping.

(2) "On fast ocean steamships," by F. Elgar.

(3) Some experiments on the combination of induced draught and shot air, applied to marine boilers fitted with serve tubes and retarders," by J. D. Ellis.

(4) "On wear and tear in ballast tanks," by A. K. Hamilton, of Lloyd's Registry.

(5) "On the transmission of heat through boiler plates," by A. Blechynden, Barrow.

(6) "On water tube boilers," by J. T. Milton, chief-engineer-surveyor to Lloyd's Registry.

(7) "On the theory of thin plating and its applicability to calculations of the strength of bulkhead plating and similar structures," by G. H. Bryan, of Cambridge.

The last paper was not read, but distributed at the meeting, the discussion being deferred until the spring meeting of next year.

On the members assembling at the Town Hall, Cardiff, on the morning of Tuesday, the 11th inst., they were welcomed by the Mayor of Cardiff, and the chair was then taken by Sir Nathaniel Barnaby (late Director of Naval Construction), the President, Lord Brassey, not having arrived. Mr. Martell's paper dealt with various details involved in the construction of oil tank steamers. It would seem at first sight a simple matter to construct a steel vessel capable of carrying oil in bulk; but this is by no means the case, and in trying to solve the problem involved naval architects have been met by some altogether novel problems. One of these is the arrangement of riveting, and with this feature the author dealt at some length, going into details in the thorough manner which his unique position enabled him to do. Without diagrams it would be impossible to follow the author in his various lines of reasoning, more especially in the matter of arrangement of tanks, the disposition of stringers, brackets, and other parts of a ship's structure. We will therefore refer those of our readers interested in

this matter to the Transactions of the Institution for details, which were fully set forth by the author.

Dr. Elgar's paper was largely of an historical nature. The author, who was until lately the Director of Dockyards, is now the chief technical and scientific adviser to the Fairfield Shipbuilding Company of Glasgow, the largest shipbuilding corporation in the world. This firm has recently constructed the Atlantic liners *Campania* and *Lucania*, at present the biggest ships afloat. The paper drew a comparison between the *Great Eastern* and these modern vessels, which more nearly approach in size the monster ship of nearly forty years ago than any vessels ever constructed. The following table is interesting as drawing a comparison between the past and present :—

	Great Eastern.	*Campania.*
	ft. in.	ft. in.
Length over all	692 0	622 0
Breadth moulded	82 2	65 0
Depth moulded to upper deck	58 0	41 6
Load draught	30 0	27 0
Indicated horse power ...	8,000	30,000
Gross register tonnage ...	18,915 tons	12,950 tons
	Knots.	Knots.
Speed at sea (full power) ...	14 to 14½	22 to 23

These figures show at once the advance in marine science and the extent to which the past naval architects more than anticipated the work we have yet done in the size of ships built ; and it must be confessed the honours appear to rest with the engineer. The *Great Eastern* was fitted with both screw and paddle wheels, an arrangement which proved a costly mistake. It should be said, however, that the marine engineer has an almost unlimited field for the exercise of his ingenuity, whilst the naval architect is fettered and bound in the most vital element of design, namely, the draught of water. It is useless to build a ship which can never enter the great ports of the world, and here we have reached a limit of 27 feet. The ship designer waits for the civil engineer to improve the chief harbours of nations before he can exercise to the full the resources which modern science has otherwise placed at his disposal. An addition of another 5 feet to the depth of some of the chief commercial ports would mean an advance in ship construction before which the growth of the last twenty years, great as it is, would be far eclipsed. For this reason it is likely that the bulk of the *Great Eastern* will be unapproached for very many years. Her length, great as it was, was a smaller proportion to her breadth than in modern ships, and to equal her displacement on the proportions of beam and length which are now considered desirable, a modern ship would require to be considerably longer than was the wonderful craft which was the embodiment of such high ambition forty years ago, and which found her most profitable employment in her last days as a show for trippers to the Liverpool exhibition.

Mr. Ellis described in his paper trials made at the steel works of John Brown and Co., of Sheffield, to show the advantage of a combination of features which the author considers desirable in the generation of steam. He uses induced draught, heating of the air supplied for combustion, and Serve boiler tubes. We have never been able to see what ground the supporters of induced draught have for claiming the great virtues supposed to exist in drawing the air through the furnace by means of a fan in the chimney, rather than driving it through by a fan in the stokehole. It is easier to grasp the advantages of heating the air supplied for combustion, supposing it is done by heat that would otherwise be wasted, but it is an open question whether this regenerative process could not be beneficially replaced by heating the feed water to be supplied to the boiler. It is certain that heat from the waste gases or products of combustion will be more readily absorbed by water than by air. In regard to the part of the system involved in the use of Serve tubes, there is perhaps less room for doubt as to the advantages to be reaped. The Serve tube may be described as an ordinary boiler tube, having on its interior a number of metal ribs which are formed in one with the tube itself. The object of these is to penetrate the stream of hot gases, often flame, passing from the furnace to the chimney, and thus act as collectors for the heat to be transferred ultimately to the water in the boiler. The principle may be described as that of the Constantine stove inverted. The device appears logical and we can accept the statement that whatever heat is taken up by the metal is readily transferred to water surrounding the tubes ; or, as one speaker during the discussion put the matter, "if we look after the absorbing surface, we know the distributing surface will look after itself." That is true so long as the distributing surface is clean, but it is to be feared such a desirable state of things is not often present in steam boilers. Later in the meeting Mr. Blechynden, in his paper, pointed out how even wiping a plate surface with greasy waste on the water side caused the rate of transmission of heat to fall off, and Mr. Durston some months back told us how bad is the inner side of tubes and plates in a marine boiler. However, the Serve tubes appear to have made a favourable impression upon engineers in spite of the difficulties in the way of sweeping, &c., which threatened them at first. The problem of their introduction appears largely to have established itself on a commercial basis. In the tables attached to his paper Mr. Ellis gave details of the trials made. From 10½ to 10½ lbs. of water were evaporated per lb. of coal from and at 212° Fahr., burning 40 to 45 lbs. of coal per square foot of grate per hour. The temperature of the gases in the smoke box was from 653 to 692° Fahr., whilst after passing through the apparatus used for transferring the heat of the gases to the air supplied for combustion the chimney gases, 386 to 391° Fahr., the difference between the two representing the arrestation of heat units by the regenerative apparatus, less accidental loss. An analysis of the chimney gases would form a valuable addition to these details, as was pointed out at the meeting. In any case, however, the boiler tested had a much better chance at Messrs. Brown's works than it would have had on ship-board ; nevertheless, the results may be said to be encouraging.

Mr. Hamilton's paper on wear and tear in water-ballast tanks was of a very special character, although a most important matter to shipowners. The moral of his investigations may be summed up in keeping boilers well off the bottom, filling tanks right up, and applying good paint properly at sufficient intervals. If it could be managed to thoroughly dry the tanks when empty it would be of more importance than anything else, but it is difficult to see how this is to be done.

Mr. Blechynden's paper was also of a special character, and gave the results of some very pretty experiments made to determine the problem referred to in the title of his paper. It would be difficult, without illustrations, to describe the experiments, but the broad general fact brought to light was, as the author stated, "that the units of heat transmitted through any of the plates per degree of temperature between the fire and water are proportional to the difference." The inference might be also drawn from the results that the steel plates lowest in carbon were also lowest in conductivity ; but the experiments, as the author said, should be extended to confirm this.

Mr. Milton's paper on water-tube boilers dealt with the subject of the hour, at any rate from a marine engineer's point of view. The paper described the most prominent types of water-tube boiler now on trial before the engineering world. By the triple and quadruple compound engine we have placed the motor so far ahead of the steam generators that marine engineers must perforce turn their attention to the first source of power on board ship. The introduction of corrugated furnaces gave the boiler a considerable step in advance, and, together with the use of steel as a material for construction, made the advances in marine engineering so well illustrated by Dr. Elgar's comparison of the *Great Eastern* and *Campania*, at all possible. Leaky tubes, however, have set us all back again, and the conviction is growing among engineers that an entirely new departure is required in boiler design. The only thing that offers is the water-tube system, in which steam is generated in a series of pipes containing water and surrounded by hot gases, rather than in a cylindrical shell through which tubes run to convey the products of combustion through their interior from the furnace to the chimney. The water-tube boiler is almost as old as the more ordinary multi-tube (fire-tube) boiler ; but unhappily the lamentable failures of a generation ago—in which several lives were lost—threw such discredit on the system that it has been tabooed ever since. We are now beginning to see how to get over the errors of the past, and the great feature now to be solved is the question of durability. That can only be settled by time ; and it seems possible that the water-tube boiler may creep from smaller to larger vessels until the shell boiler becomes a thing of the past on shipboard ; at least that is the opinion of some marine engineers whose word is entitled to the highest respect. Possibly in the meantime a practical way may be found of generating power in the motor itself without the intervention of

steam and the apparatus for generating it. Before that time arrives, and some form of gas engine (including oil engines) arrive, a distinctly new departure will have to be made equivalent to that of the separate condenser of Watt.

The last paper in the list, that of Mr. G. H. Bryan on bulkheads, was in some respects the most promising and most suggestive of the meeting. The bulkhead question has been troubling the most thoughtful of our naval architects for some time past. Dr. Elgar attacked the question some time back in a paper he read before the Institution, and Mr. Martell also read a memoir on the subject. Some time ago a strong Government committee was appointed to consider the problems involved in this matter, and a report was issued. Rightly or wrongly, some naval architects are not satisfied with the position in which the report left the question. It is considered by many of the more thoughtful that a more scientific method of dealing with the problem should be evolved. Mr. Bryan, who is a Cambridge mathematician of high reputation at his University, has been led to take the matter up, and the present paper is an effort to bring higher mathematics to the aid of the solution of the question. The paper, however, contains nothing that need appal any naval architect or engineer who can lay fair claim to the title, and it is eminently practical. The similes selected by the author are of the simplest nature; indeed, the memoir reads more like a contribution from the pen of the late Mr. Froude, who was a very prince of lucidity and simplicity. We are reluctantly obliged, through want of space, to treat this paper as we have the others read at this meeting, and only give a suggestion of its scope, referring our readers to the Transactions of the Institution for fuller details. Mr. Bryan attacks the theory, still held by many engineers, that the plate may be regarded as consisting of a series of parallel strips supporting pressure by their tensions. Euler's and Bernouilli's early theories have been abandoned by mathematicians, and Mr. Bryan is now trying to persuade engineers to do the same in effect in giving up the "parallel strip" illustration. The matter affords an excellent example of the manner in which the student of higher mathematics may assist the engineer. We may add that it is proposed to discuss the subject at the next meeting of the Institution to be held next spring, and doubtless Mr. Holmes, the secretary of the Institution, would forward a copy of the paper to any one wishing to take part in the discussion. The address of the Institution is 5, Adelphi Terrace, Strand.

SOCIETY OF CHEMICAL INDUSTRY.

THE Annual General Meeting of the Society of Chemical Industry was opened at University College, Liverpool, on July 12, when Sir John Evans, K.C.B., Treas. R.S., delivered his Presidential address as follows:—

"When I look at the list of those who in past years have occupied the Presidential chair of this Society, all of them men eminent in the departments of either theoretical or practical chemistry, or, indeed, of both, I cannot but feel my own insufficiency to succeed them in worthily fulfilling the duties of this post. I am, indeed, tempted to inquire how and why it was, that, in accordance with the pressing invitation of some members of the Council, I ever consented to allow myself to be placed in nomination as your President. It certainly was not on the grounds of any fancied chemical attainments; nor was it from my having been in former years associated with any industry that is usually regarded as being specially connected with chemistry. Far less was it in the hope that any remarks that I might be called upon to make while acting as your President could be of any particular interest or value to those who, in all probability, are far better acquainted than I can pretend to be with any subject that properly comes within the scope of such a Society as ours. I believe, however, that the main reason that I had for allowing myself to be brought forward is one that will, to a great extent, palliate my shortcomings in so many of the essential requisites for such an office. It was the hearty and entire appreciation that I felt of the work and aims of such a Society as that of Chemical Industry, that was the prime mover in the case. Whether I regarded the organisation of the Society, with its sections at all the principal centres of chemical operations, each to a certain extent independent, but all working harmoniously together, and forming one powerful and important body, with high objects and aspirations before it; or whether I looked at it as presenting a bond of union between industries apparently unconnected, while, at the same time, furnishing information of the most useful character to each and all, I could not but recognise it as a body in the highest degree conducive to the public welfare; so that on these, if on no other grounds, I should have been wanting in public spirit had I stood aloof when others urged me to accept the post of your President.

"It is, I firmly believe, only by some such cordial co-operation among the different industries of this country as that which our Society has inaugurated, that the commercial position of Great, or Greater, Britain is to be maintained; and the more fully the interdependence between one branch of manufacture and another is recognised and acted upon, the more likely are we, as a whole, to maintain our place in the keen race of competition with other countries.

"A merely cursory glance at our Journal will at once show how numerous are the departments of British industry that are more or less dependent on chemical knowledge, the information given on current literature and the specifications of new patents being arranged under no less than three-and-twenty different heads, many of them embracing several varying occupations. Not a few of these headings would, within my own memory, have conveyed but little meaning even to experts. I need merely carry back the minds of some of the elder members of the Society, not only to the days when aniline colours were not and Dr. Perkins was comparatively unknown, but to the time when lucifer matches had not been invented, when photography was practically non-existent, and when in most of those industries in which a knowledge of chemistry is now regarded as indispensable, the 'rule of thumb' reigned absolute.

"I can speak of those old times with some personal feeling, as it is now upwards of fifty years since, that having presumably completed my education, I first entered a paper-mill in order to learn the art and mystery of the manufacture of paper, with which the name of the firm of which I was until lately a member—that of John Dickinson and Co.—has been so long, and, I may venture to say, so honourably connected. It was, of course, recognised that some knowledge of chemistry was a requisite in such a manufacture, but I must freely confess that our methods were of the rudest, and that it was only as years rolled on, and first esparto fibre, and then the different kinds of wood pulp were introduced into the manufacture, and the various methods and results of sizing studied, that a thorough acquaintance with chemical laws became a *sine qua non* for those who hoped for success in this branch of industry.

"At the date that I have in view—say 1840—although rags were the staple material for the manufacture of paper, our consumption of them was but small, and they were principally used by us in producing paper for copper-plate work—steel plates at that time being rarely used—and for the highest class of printing papers. We consumed, however, a large quantity of raw material in the shape of the waste arising in the manufacture of linen and cotton goods, and we had collecting agents at Dundee, Belfast, Bradford, Leeds, and Manchester, who bought the waste upon the spot. At Manchester we had a mill, in which the cotton-waste was cleaned, boiled, and converted into what is known as 'half-stuff,' which was finally bleached and made into paper at our Hertfordshire mills. In that county we had another 'half-stuff' mill, at Rickmansworth, where the linen waste was treated. The boiling was carried on in open keirs, or such as were partially closed, and always at a low pressure, as high pressure boilers for such materials were practically unknown. Most of the waste was twice boiled, first with caustic lime, and secondly with a small amount of soda. The 'shieves,' or woody particles, that were unreduced by the boiling, were got rid of by a long process of screening, or 'devilling,' after the 'half-stuff' had been dried so far as possible in hydraulic presses. The material was then bleached in stone chambers by the direct action of chlorine gas, produced on the spot in retorts. At the mills, however, where the 'half-stuff' was converted into paper, the remains of the chlorine had to be washed out, and the final bleaching of the stuff to be effected with bleaching salts. No process for the recovery of the soda used in boiling was then known, and, indeed, the quantity used was so much less than that which is now necessary with esparto, that it would not have paid to recover it. I remember, however, being engaged in some experiments for the recovery of the manganese from the spent liquor of the retorts. Even when first Mr. Routledge introduced the use of esparto fibre no evaporating or recovery

process was employed, but the double advantage was soon seen of avoiding the nuisance of polluting the streams into which the waste liquors were allowed to flow, and of regaining a quantity of soda at a small cost. With the general adoption of esparto as a material a radical change in the manufacture of paper was effected, and the difficulties in which the industry had been placed by reckless commercial legislation with regard to foreign rags in a great degree removed.

"What has taken place in the manufacture of paper has been paralleled in numerous other departments of commercial enterprise, and not the least in those connected with the manufacture of chemical products themselves, in many, if not indeed in most of which a complete revolution has been effected within the last fifty years, or even less. It would be a hopeless task to try to indicate the whole of the advances in chemical knowledge that have been made within that period, and yet I am tempted to give some few reminiscences of the condition of the science as exhibited in *Brande's Elements of Chemistry*, published in May, 1841, exactly twelve months after my first introduction to business, when compared with our knowledge at the present day.

"Chemistry at that time was by no means in its infancy. Its foundations had been securely laid not only on the Continent, but in this country, and the names of Priestley, Cavendish, Scheele, Lavoisier, Davy, Wollaston, and other English investigators were already household words. There were, in 1841, twelve simple non-metallic substances known, from oxygen to boron, including selenium, and forty-three metals from potassium to silicium, including lantanum and thorinum. For all fifty-five, symbols had been arranged, but these were in many respects different from those which are now in universal use. C, for instance, stood for chlorine and not for carbon, while B symbolised bromine and not boron. Potassium was designated by Po and not by K, and sodium by So and not by Na, while uranium was known as Urnm and not as U.

"The atomic weights of the various substances had been approximately determined, though modern investigations have in some instances materially changed their ratio. Though hydrogen has retained its place as the unit, oxygen is no longer represented by 8, but by 15·96, or even less. Sulphur that was then 16 is now 31·98. Selenium, instead of 40, has now 78 assigned to it; while the number for tellurium has been increased fourfold from 32 to 128, and phosphorus has gone up from 16 to 30·96. Whether all our present figures will stand the test of time remains to be seen, and indeed recent researches have shown cause to doubt the accuracy of some of the figures that I have quoted. For myself, as a somewhat profane outsider, I must confess that it would be a source of satisfaction if future investigations should show that the figures now having three or four places of decimals attached to them might more properly be converted into integers, and oxygen came out boldly as 16, and sulphur as 32. This is, however, a digression.

"Turning to the simple substances and metals of which, as already stated, 12 and 43 respectively were known in 1841, we find them now slightly increased. Of non-metals we reckon 15, and of metals 48. Some metals, like columbium and glucinum, have dropped out of our list, the latter having now become beryllium, while others, like cæsium, didymium, erbium and rubidium, have come in.

"On the whole, the changes and advances in inorganic chemistry have not been extreme. It is in organic chemistry that what cannot be regarded as anything short of a revolution has taken place. It is not a matter on which I can dilate, but as indicative of what has been going on I may mention that while three volumes have sufficed to Roscoe and Scholemmer for inorganic chemistry, no less than six have already appeared in continuation treating of organic chemistry, and more are to follow; so that the proportions have been reversed which prevailed in the days of Brande, who devoted 367 pages only to organic chemistry, and 1042 to introductory matter and inorganic chemistry.

"But whatever may have been the advances in chemistry within the last fifty years, whether as a pure or an applied science, the extension of its boundaries towards physics in the one direction, and biological studies in the other, is at least as remarkable. While the study of spectrum analysis has rendered most valuable assistance in the chemistry of the constituent substances with which we are familiar upon earth, it has enabled the astronomer to carry his speculations not only to the constitution of the sun and stars, but to that of nebulæ, comets and meteors, and in the hands of Mr. Norman Lockyer and Mr. Huggins may yet lead us to travel with some degree of confidence in paths hitherto untrodden. In the domain of electricity it is hard to say whether that science does not owe nearly as much to chemistry as chemistry does to it. In the practical application of electricity to lighting purposes, chemistry has still to be called on to produce some improved form of secondary battery, and some portable form of primary battery which shall prove of ready application by our miners. It is needless to recall how much our underground workers are indebted to chemistry for their comparative immunity from danger from fire-damp, a danger which the efforts now being made by chemists will, I hope, still further diminish. Electricity has also placed at the command of chemists greater intensity of heat than can be derived from ordinary sources.

"The study of heat, irrespective of electricity, has largely reacted on chemistry, and while the Bessemer process has entirely revolutionised the manufacture of steel, and almost annihilated the distinction in value between that and other forms of iron, the Siemens and other furnaces have led to unprecedented economies in the expenditure of fuel, and at the same time have facilitated the application of heat in various chemical processes. In the other direction—the absence of heat—Prof. Dewar has, during the present year, made most important advances. Although air had previously been liquefied, he has now been able, by means of intense cold alone, to reduce atmospheric air to the liquid condition. His further results, by a combination of enormous pressure and extreme cold, are well known, and now that oxygen and nitrogen have yielded themselves to the advances of science and have been obtained in quantities in a liquid state, it is hard to say that hydrogen is destined always to remain intractable. What may be the ultimate result of the investigations that can now be carried on at temperatures ranging from 100° to 200° centigrade below the freezing point of water, it is impossible to foresee. From researches already made in this country and in France, it would appear that most substances under extreme cold are, so to speak, dead, and that their ordinary affinities are in abeyance. Possibly what may be termed 'glacial chemistry' may eventually enlarge our views as to the various properties of matter.

"As to the advances in our knowledge of the chemistry of light, the present condition of photography may testify. When we can take the image of a bullet flying at the rate of 3,000 feet per second, with its accompanying cone of compressed air; when we can produce photographs which are practically permanent, and when we call in the action of light to engrave our steel or copper plates, and to produce efficient substitutes for woodcuts, we seem to be getting near the limits of the practical application of photography. And yet many of us may remember the days when the daguerrotype was regarded—and justly so—with wonder; and I can myself call to mind a still earlier form of photography, by which natural leaves were reproduced on paper sensitised with a salt of silver, of which I saw specimens in an exhibition at Dresden so long ago as the year 1839.

"In the introduction of artificial light much also has been done. It is true that Pall Mall was experimentally lighted by gas in 1807, but it was not until 1842 that gas found its way into Grosvenor-square and some other aristocratic quarters of the metropolis. Since that time immense strides have been made in the process of gas manufacture, while, in consequence of the waste products arising in the process having now found commercial uses, great reductions have been made in its cost. At the present time gas has to compete with electricity as an illuminant, while, in many cases, it has been superseded by mineral oils, which are now so abundant and cheap, and of which in this Society the flashing point may be said to be almost a burning question. If, however, gas is losing ground as an illuminant, it seems to be gaining it as a source of power, and there are prospects of a considerable increase in the use for this purpose of hydrogen and its compounds, containing far less carbon than ordinary coal-gas.

"In metallurgy also, in addition to the improvements in the manufacture of steel already mentioned, many noteworthy discoveries have been made. One of the most important of these is perhaps that of the production of aluminium on a cheap scale and in quantities sufficient for various applications to ordinary use. It seems somewhat remarkable that the progress in the use of a metal at once so light and so strong is not more rapid.

"The applications of some of the more modern alloys, such as

phosphor-bronze, seem also susceptible of considerable further development.

"The extensive manufacture of sodium affords another instance of what was formerly the mere subject of a laboratory experiment, being now conducted upon a commercial scale.

"I may here just glance at the attempts that have been made to produce artificially some of the precious stones that occur in nature. Rubies have been manufactured, not indeed such as could rank as gems, but still such as will serve to 'jewel' the pivot-holes in watches; and though the results of attempts to produce the crystallised form of carbon, which is known as the diamond, have as yet had but doubtful success, it does not appear to me that the prospect of producing genuine diamonds under combined heat and pressure is absolutely hopeless.

"Another direction in which great advances have been made, and in which it seems probable that there yet remains something to be discovered, is the grouping of the various elements into small divisions, having more or less analogy the one with the other, and the classification of the atomic weights in one harmonious series. What is known as the Periodic Law of Mendeleeff and of our own Mr. John A. R. Newlands, has suggested the possibility that what we now know as metals or elements may have some at present hidden connections between them, so that eventually some of them may prove to be rather compound bodies than strictly elementary substances. This, however, is for the chemistry of the future.

"In organic chemistry, which has been defined to be the chemistry of the hydro-carbons and their derivatives, it is, as I have already observed, that the most wonderful development has taken place within the last half-century. Who, for instance, in 1840 could have foreseen the important part that aniline was to play in dyeing and colouring? It was not, I think, till 1856 that Perkins's mauve was really brought into commercial use, but since that time what a rainbow of colours has been produced from what would have seemed a most unpromising source! How brilliant are their hues, but as yet, in many cases, alas, how fugitive! Regarded from an artistic point of view these colours can hardly be esteemed an unmixed blessing; and even the fabrics of Eastern looms have not escaped their influence.

"Quæ regio in terris nostri non plena *coloris?*"

Turkey, Persia, India, and China have, I fear, in many cases, sacrificed taste to cheapness, and harmony to splendour in colour. It is a source of some satisfaction to know that the woad with which our ancient British predecessors stained their bodies is still cultivated among us for the purpose of dyeing wools, even though it has acquired the name of *Isatis tinctoria* and the colouring extract is now classed as an *Indigotin*.

"Among inorganic colours I may here briefly mention ultramarine, which instead of being patiently produced by the careful treatment of lapis lazuli and sold at many shillings an ounce, is now manufactured by the ton and quoted by the hundredweight. Would that the artificial colour was as fine and permanent as the natural! I have, in my own time, seen it supersede smalts as a colouring matter in paper-making, and I have known its use not unfrequently accompanied by the abundant presence of sulphuretted hydrogen as a product of its decomposition.

"Not only colouring matters but our flavours and scents have been synthetised, though art, if superseding nature for a time, must eventually acknowledge her inferiority even in pear-drops. Whatever our æsthetic feelings under these circumstances may be, we cannot but admire the skill and scientific energy by which such results have been attained. How far 'saccharine,' one of the lastest results of the chemist's ingenuity, is likely to supersede the use of ordinary sugar, is a question on which I decline to speculate. The manufacture of our every-day sugar has, however, itself undergone a complete metamorphosis within the last fifty years, with the result that it is now produced at what would formerly have been regarded as an absolutely impossible price. In 1840, beet-sugar was in its infancy, and such has been the improvement in the growth of the beet and the process of manufacture that nearly twice the weight of sugar is now produced from a ton of beetroot as there was at that date. In the production of cane-sugar also immense economies have been effected, especially in the process of evaporation. The study of the effects of saccharine solutions on the polarisation of light, and our acquaintance with the distinctions between dextrose and lævulose, and of the conversion of starch into sugar, all come within comparatively modern times.

"Much of our knowledge of the mysterious processes of fermentation is also of recent date, and it is in connection with these processes that the chemist finds himself brought into close contact with the botanist and the physiologist.

"Whatever suspicions Leeuwenhoek and the early microscopists may have had with regard to the vegetable character of yeast-cells, and however clearly Cagniard de Latour and Schwann may have established its plant-like nature and its connection with fermentation, it was not until Pasteur's researches from 1857 to 1861 that the true character of the yeast-plant, and of other micro-organisms which lie at the base of most fermentative processes, can be said to have been absolutely demonstrated. The beneficial effect of his inquiries, and of his methods of obtaining a pure cultivation of yeast, is universally recognised, and has reacted in the most remarkable manner on the brewing industry.

"But M. Pasteur's researches have also led to much wider results, as it has been mainly in consequence of his careful observations that the wonderful influence for good or for evil of organisms so minute as in some cases almost to defy the power of the microscope, has now been so fully recognised. The germ-theory of the origin of many diseases meets with much more general acceptance than it did but a few years ago; and though the bacilli and bacteria which are characteristic of some virulent diseases, such as anthrax, are only agents in certain fermentative processes by which poisonous matters are engendered, their existence and character seem to be placed beyond all doubt. The process of obtaining immunity from the action of these poisons by the gradual introduction of the virus into the animal system, thus rendering it insusceptible of receiving further injury from the same poison, has been successfully introduced, both among men and beasts, and hydrophobia and anthrax have been successfully combated.

"A recognition of the influence of germs has led to the introduction into surgery of that antiseptic system of treatment with which the name of Lister will always be associated, and which has done so much to diminish suffering and preserve life. While upon this topic I may just allude to another instance in which chemistry has come to the assistance of medical science, I mean in the production and investigation of those anæsthetic agents which play so important a part in modern surgery, and which have done so much to alleviate human suffering.

"But while the ferments produced by micro-organisms are on the one hand so pernicious, it is very doubtful whether, on the other, they are not equally beneficial, if it be really the case that such processes as digestion are in a great measure due to their action. How far the nitrification of the soil may be due to micro-organisms is a question not yet absolutely solved, though strong presumption has been raised of their being, at all events, potent factors in the case.

"Now that so many diseases have been traced to pathogenic organisms which are constantly present in water contaminated by sewage, the question of the vitality of these organisms and their germs has been rightly regarded as one of great public importance, and the Royal Society, in conjunction with the London County Council, has instituted an investigation into it, which is being diligently prosecuted both from the botanical and the chemical points of view. The remarkable power of light, whether that of the sun or electric, in sterilising the germs of some micro-organisms, already to some extent previously known, has been conclusively demonstrated by Prof. Marshall Ward.

"Much has been done of late years by chemists towards the purification of sewage with the view of rendering the effluents from the ultimate drains of our large municipalities as innocuous as possible, and the results obtained have been in many instances satisfactory. They would, no doubt, have been even more so had not the imperative demands of economy limited the cost. Still, whatever may be done, I am inclined to think that there is much truth in the metrical abstract of a paper read some years ago before the Royal Society:—

> "Sewage, however disinfected,
> Is not from ill results protected;
> Though made to all appearance pure,
> It still remains not safe, but sewer."

"I will not attempt to discuss the important question of the disposal of the sewage of our great towns, but to many it will appear as somewhat of a disgrace to our powers of applying chemical

knowledge, that such vast accumulations of what were originally highly fertilising substances should be discharged into the estuary of the Thames, and not only be absolutely wasted, but converted into a perpetual nuisance, brought up at each tide within the limits of the metropolis from which they started.

"It is true that within the last fifty years we have imported enormous quantities of guano, phosphates, and nitrates, but of these there must eventually become a scarcity, if not an end. In the meantime, may not chemists do something to reduce the waste of fertilising agents that is now taking place among us? Agricultural colleges have been founded—agricultural chemistry is a recognised branch of science; but with increase of knowledge has come increase of foreign competition, fostered by improved means of transport and communication, and it is at the present time a doubtful point whether many soils, even if rent-free, can be cultivated in this country for cereals, except at a loss.

"While touching on agricultural chemistry, I cannot pass over in silence the experiments which have now been carried on continuously for a period of fifty years at Rothamsted, by Sir John B. Lawes, assisted during the whole half-century by Dr. Gilbert. The extremely liberal provision which, during his life-time, Sir John Lawes has made for the purpose of continuing and extending his experiments, would alone entitle him to a full measure of public gratitude. When, however, we consider the nature and extent of the experiments already conducted, we must feel that no expression of public estimation can be too high when, as will shortly be the case, the Rothamsted jubilee is celebrated. As to the results already obtained, and as to the nature of the experiments still being carried on, it would be out of place here to enlarge. Remarkable, however, as are the effects of different manures on the botanical character and growth of herbage, and on the strength and yield of cereals, the different results arising from the mere variation of the temperature, sunshine, and rainfall, in successive years, are more remarkable still.

"I feel, however, that I have detained you long enough with these crude considerations of topics more or less chemical in their character, and that it is time for me to conclude.

"We are here assembled on the borders of the two counties of Lancashire and Cheshire, in both of which are great centres of chemical manufactures, and the principal productions of which are in a great degree dependent on the knowledge and due application of chemical laws. We meet at the seat of one of the most active sections of the Society of Chemical Industry, which has received us with open arms, and has provided us with an 'Open Sesame,' which will admit us to inspect many of the most interesting of the works and factories of the district. We gladly avail ourselves of the opportunities thus liberally opened to us, and if by chance any of us can afford assistance, advice, or encouragement to our brethren in Liverpool, I am sure that all present will gladly render it, and not forget that we are all members of one body, and all mutually interested in the advance of chemical knowledge, and especially of Chemical Industry."

THE PLAGUE OF FIELD VOLES.

RATHER more than a year ago a Committee was appointed by the Board of Agriculture to inquire into and report upon the circumstances attending the existing plague of voles in some of the southern counties of Scotland; and to ascertain, either experimentally or otherwise, whether any, and if so what, preventive and remedial measures could be adopted, and under what conditions those measures were likely to be of value.

The committee consisted of Sir Herbert Eustace Maxwell, Bart., M.P. (chairman), the Right Hon. the Earl of Minto, K.T., the Rev. John Gillespie, Prof. D'Arcy W. Thompson, and Mr. Walter Elliot.

Mr. J. E. Harting, Librarian of the Linnean Society, acted as the Secretary to the Committee.

From the recently-published report we obtain the following information. "The animal, which by excessive multiplication has caused so much mischief on hill-farms in the southern uplands of Scotland, is the short-tailed field-vole (*Arvicola agrestis*). At all seasons it is a well-known inhabitant of our pastures and may be found at all heights from sea-level to near the summits of our highest mountains. It usually produces three or four litters a year, each consisting of from four to eight young, but in some seasons they are even more prolific, the breeding season is prolonged, young voles being observed from February to November, and the litters containing as many as ten young.

"The present outbreak may be traced back to the year 1888, when the voles were observed to be increasing on the farm of Glenkerry and others in Selkirkshire. In the summer of 1889 the low-lying pastures near Closeburn, in Dumfriesshire, were observed to be infested by enormous numbers of voles, which remained there during 1890, and disappeared in 1891, probably moving up to the hill pastures, where in June 1892 they were swarming.

"The districts principally affected are the hill pastures in the north-west of Roxburghshire, the south of the counties of Selkirk, Peebles, and Lanark, and the northern part of Dumfries from Eskdalemuir by Moffat to Thornhill. The voles have also appeared in great numbers in the parishes of Dalry and Carsphairn, in the stewartry of Kirkcudbright.

"Mr. R. F. Dudgeon has estimated that in Roxburghshire 30,000 to 40,000 acres had been affected, of which he considered 12,000 to 15,000 acres had been rendered useless; in Dumfriesshire 40,000 to 50,000 acres, and in the stewartry of Kirkcudbright 10,000 to 12,000 acres were described by him as infested by voles."

"The map accompanying the report of the Committee shows that an area not less than 600 miles in length and from 12 to 20 miles in breadth has been overrun.

We reprint the following conclusions and recommendations contained in the report.

"The Committee have reluctantly been led to the conclusion that they are unable to recommend any specific method of dealing with or putting an end to the present outbreak.

"It appears to be an instance of the power which small animals are well known to possess, of prodigiously rapid multiplication under favourable climatic conditions and with a plentiful supply of natural food.

"Experience shows that a combination of such favourable conditions will always tend to bring about a recurrence of the plague. That being so, it ought to be the endeavour of every farmer and shepherd to be on the alert, and report without delay to the land agent, and to the secretary of the local farmers' club, or agricultural society, the first signs of the multiplication of vermin, so that palliative measures may at once be adopted, not on isolated farms, but everywhere throughout the district.

"The most effective measures appear to be periodical and timely burning of grass and heather, followed by active pursuit of the vermin by men using wooden spades and dogs. If this were promptly done in the early stages of the outbreak, it is quite possible that it might be averted altogether, or greatly mitigated in severity.

"It is hardly necessary to point out that the proprietor of the land should be informed as soon as anyone else, because his keepers and others might be usefully employed in assisting to prevent what amounts, if unchecked, to a common calamity upon all classes connected with land.

"Where plantations of limited extent are attacked, pit-falls wider at the bottom than at the top and about 18 inches deep should be dug. The voles fall into them and cannot escape, and the ground is soon cleared of them in this way.

"The Committee cannot speak with approval of the use of poisoned grain, except where the area affected is very limited.

"Nor have they been able to come to any conclusion favourable to the adoption of Prof. Loeffler's method of destroying voles by means of bread saturated in a preparation of the *bacillus typhi murium*, or mouse typhus. The personal investigations made by the chairman and secretary in Thessaly (where in May 1892 Prof. Loeffler was employed at the expense of the Greek Government to combat the plague of field-voles then prevailing in that country) convinced them that the favourable reports circulated as to the complete success of the experiments have not been justified by the results. In certain parts of Thessaly the voles were reported by landowners and others to be as numerous in January 1893 as ever they were.

"The Committee readily admit that, when used in a fresh state, the bacilliferous fluid is an effective though somewhat dilatory poison for mice and voles, and has this advantage over mineral poisons that, as has been proved, it is innocuous to human and other forms of life.

"It has also been reported by Prof. Loeffler that the Scottish voles sent to him alive by instructions from the Committee have been found as susceptible of the mouse typhus bacillus as their

Greek congeners. But there are three objections which render this method almost worthless except for employment in houses, gardens, enclosed fields, or other limited areas :—

"(1) It is very expensive ; the virus supplied to the Greek Government was paid for at the rate of 4s. a tube, containing enough when dissolved to treat about two imperial acres, a cost which in many instances would exceed the rent of the Scottish hill pasture. To this must be added the price of bread used in distributing the virus, which would appreciably raise the cost of the process. Thus to deal effectually with a hill farm of say 6000 acres, would entail an expenditure of from £700 to £1000, making the remedy more costly than the evil.

"(2) Mouse typhus is not contagious ; it can only be communicated to those animals that will swallow some of the virus. The allegation that healthy voles will become infected by devouring the bodies of the dead has not been satisfactorily proved. That Greek voles when in captivity have been observed to feed upon the corpses of their fellows hardly warrants the assumption that Scottish voles in a state of liberty will do the same ; and unless the disease were communicable from one animal to the other, it is not easy to see how the remedy could prove effective on extensive hill pastures.

"(3) The fluid loses its value in about eight days after preparation. Consequently much disappointment might ensue if, after a supply had been obtained, a fall of snow or wet weather were to interfere with its distribution over the land.

"The remedy which has been found most effectual in Thessaly is an injection of the fumes of bi-sulphide of carbon into the burrows. This, however, is a more expensive process than the other, besides being injurious to the health of those engaged in its application. It is, moreover, inapplicable to the Scottish vole (*Arvicola agrestis*), which does not burrow to a depth like the vole of Thessaly (*Arvicola Güntheri*), but lives in shallow runs amongst the roots of herbage.

"With the under-noted exceptions the natural enemies of the voles may be divided into two classes, viz., those which destroy the voles, and are harmless to sheep, crops, and game ; and those which, though preying on voles, are so hurtful in other ways as to have no claim to preservation :—

(i.) Vole-killers, harmless, or nearly so, to sheep, crops, and game.	(ii.) Vole-killers, hurtful in other ways.
Owls of all sorts,	Foxes,
Buzzards,	Ravens,
Kestrels,	Carrion and Hooded Crows,
and the smaller Seagulls.	Great Blackbacked Gulls,
	and Adders.

"Strict injunctions ought to be given by landowners that the birds mentioned in the first class should not be destroyed. Their presence in full numbers, though inadequate to avert an outbreak, would undoubtedly tend to mitigate it, and, as has been proved in the case of the short-eared owl, they have the faculty of multiplying a normally in presence of an unusual supply of food. They are at all events most useful allies to man in combating attacks of ground vermin.

"The Committee further deprecate in the strongest manner possible the use of the pole-trap for the capture of hawks. Besides the inhumanity of this device, it is indiscriminate, and harmless owls, kestrels, and buzzards are just as likely to be taken by it as are the more mischievous species.

"Three animals, diligent vole destroyers, have been omitted from both these lists, because they are undoubtedly hurtful to game. The first of these is the common rook (known to the shepherds as the corn crow), of which, however, the services to agriculture are now generally recognised.

"The other two animals referred to are the stoat and weasel. Of all the smaller beasts of prey these are perhaps the most hateful to gamekeepers, and it is hardly reasonable to expect that stoats should be allowed to multiply in game coverts, or in the vicinity of pheasant coops. But the Committee have no hesitation in recommending that weasels, which are persistent mouse-hunters and do little damage to game, should not be molested, at least on moorlands and hill pastures, where they can do little harm and much good."

THE ZOOLOGICAL SOCIETY.

THE report of the Council of the Zoological Society of London for the year 1892 was read at the annual general meeting on April 28, and printed copies of it were distributed shortly afterwards. The following extracts are of general interest.

"The considerations which prompted the Council of the Society, as announced in their report last year, to award two of its medals to the representatives of families through whose exertions the Great Skua has been retained as a veritable member of the British fauna, have induced the Council to act this year in like manner in regard to a still scarcer species—the osprey (*Pandion haliætus*). It has been represented to the Council that for some years past but three pairs of this bird, which on many accounts is of great interest, have regularly bred in Scotland, and that their protection has been an object of much solicitude to those on whose property the nests are built. The Council are able to state that the effect of their former award has not only been beneficial to the birds concerned, but has been highly appreciated by the public at large, and they trust that the same good result will follow the bestowal of the Society's silver medal upon Donald Cameron, of Lochiel, and John Peter Grant, of Rothiemurchus, in recognition of the efforts made to protect the osprey in their respective districts."

These medals were presented to the above-named gentlemen at the general meeting of the Society on June 22.

Reference was made to the resolutions adopted by the Council in regard to steps proposed to be taken by the Government of New Zealand for the preservation of the native birds of that country. The resolutions were as follows :—

"That the Council of this Society have learnt with great satisfaction the steps that were proposed to be taken by the Earl of Onslow, when Governor of New Zealand, and by the Houses of General Assembly, for the preservation of the native birds of New Zealand, by reserving certain small islands suitable for the purpose, and by affording the birds special protection on these islands.

"That the Council much regret to hear that difficulties have been encountered in carrying out this plan as regards one of these islands (Little Barrier Island), and trust that the Governor of New Zealand may be induced to take the necessary steps to overcome these difficulties, and to carry out this excellent scheme in its entirety.

"The Council venture to suggest that, besides the native birds to be protected in these reserves, shelter should also be afforded to the remarkable Saurian, the Tuatera lizard (*Sphenodon punctatus*), which is at present restricted to some small islands on the north coast of New Zealand in the Bay of Plenty.

"The number of visitors to the Society's gardens in 1892 was 605,718. The corresponding number in 1891 was 598,730, showing an increase of 6988 entrances.

"The deaths during the past year have been 862 in number, being 40 in excess of the number of deaths during 1891. Of these the more important were—a lioness, a male cheetah, two common zebras, an aard wolf, a male beatrix antelope, and the last surviving giraffe.

"Two gentlemen have utilised the students' rooms for carrying on investigations. Mr. F. G. Parsons has been studying the comparative myology of the rodents ; and Mr. P. Chalmers Mitchell has commenced an investigation upon the spleen of the vertebrata.

"The number of animals belonging to the first three classes of vertebrates living in the Society's menagerie at the close of 1892 was 2413. The corresponding number on December 31, 1891, was 2232.

"The total number of registered additions to the menagerie in 1892 was 1335, of which 698 were acquired by presentation, 315 by purchase, 141 were bred in the gardens, 142 were received on deposit, and 39 obtained in exchange.

"Among the deaths of animals in 1892 occurs that of the last remaining individual of the stock of giraffes, a male, purchased January 27, 1879. The Society is now, for the first time since the arrival of the four original giraffes on May 24, 1836, without any representative of this mammal in its series. Nor does there seem to be at present much chance of our being able to supply the deficiency. Owing to the closure of the Soudan by the Mahdists the supplies of this and other large African mammals, which were formerly obtained *via* Cassala and Suakim, have ceased, and, so far as can be ascertained, there are now no living giraffes in the European market. There have been thirty individuals of the giraffe in the Society's gardens since 1836, of which seventeen were born there, and thirteen acquired by purchase. Of these thirty, one was presented to the Royal Zoological Society of Ireland in 1844, five have been sold at prices varying from £450 to £150, and the remainder have died in the gardens.

"In concluding their Report the Council express their regret that it has not been possible, during the past year, to continue their former policy of adding to the permanent structures in the gardens. There are still several buildings much wanted for the better housing of certain parts of the collection, amongst which may be specified the anthropoid apes and the struthious birds, for which groups special accommodation is required. But in both these cases, to carry out the plans efficiently, a considerable expenditure would be necessary, and the margin of receipts over expenses is at present too slender to render it prudent to undertake the work. The Council look forward to the time when the small remaining balance of the mortgage-debt upon the Society's freehold house will be paid off, and when there will be at any rate a better prospect of devoting the surplus income to such purposes."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE following is the list of scholarships and prizes just awarded at the Royal College of Science, London, with which is incorporated the Royal School of Mines:—First year's scholarships, Robert W. Forsyth, George W. Walker, John Thomas, Harry R. Prescott; second year's scholarships, Bernard E. Spencer, George S. West; "Edward Forbes" medal and prize of books for biology, Henry Lacey; "Murchison" medal and prize of books for geology, Joseph B. Morgan; "Tyndall" prize of books, for physics (Course I.), George D. Dunkerley; "De la Beche" medal for mining, Samuel W. Price; "Bessemer" medal and prize of books for metallurgy, Allan Gibb; "Frank Hatton" prize of books for chemistry, Robert E. Barnett. Prizes of books given by the Department of Science and Art: Mechanics, William H. Pretty; astronomical physics, William E. Tubbs, Willie Whalley; practical chemistry, Robert E. Barnett, Gerald G. Quinn; mining, Samuel W. Price; principles of agriculture, Robert S. Seton.

DR. BUTLER, Master of Trinity College, Dr. Hill, Master of Downing College, Dr. Peile, Master of Christ's College, Dr. Sidgwick, Knightbridge Professor, Dr. Jebb, Regius Professor of Greek, Dr. J. Ward, Dr. Keynes, Mr. F. E. Kitchener, Mr. R. T. Wright, and Mr. A. Berry will represent Cambridge University at a conference on the relations between the work of the Universities and the work of secondary education in England, to be held at Oxford on October 10 and 11, 1893.

MR. HENDRICK, of the Royal Agricultural College, Cirencester, has been appointed lecturer and demonstrator in agricultural chemistry by the Glasgow and West of Scotland Technical College.

PROF. W. GARNETT, M.A., D.C.L., Principal of the Durham College of Science, Newcastle-on-Tyne, has been appointed director and technical adviser to the Technical Education Board of the London County Council.

SCIENTIFIC SERIALS.

THE most important papers in the *Botanical Gazette* for April and May are an account of a newly-discovered fungus, *Phyllogaster saccatus*, by Mr. R. Thaxter, proposed as the type of a new family, *Phyllogastreæ*, characterised by the absence of any volva or receptacle differentiated as such in the mature condition; on the tendrils of *Passiflora cærulea*, by Mr. D. T. McDougal, in which the author states that the tendrils of the passion-flower are sensitive to contact with one another, contrary to Darwin's experience with *Bryonia* and *Echinocystis*; on the limitation of the term "spore," by Prof. C. McMillan, which does not seem to throw much light on the confusion at present prevailing; the commencement of a paper, by Mr. G. F. Atkinson, on the biology of the organism which causes the root-tubercles in the *Leguminosæ*; and on the genus *Corallorhiza*, by Mr. M. B. Thomas, who finds in the cells of the cortical tissue hyphal threads which he regards as the agent by means of which the plant is able to derive nutriment saprophytically from the decaying vegetable matter around it.

IN the *Journal of Botany*, for May and June, in addition to the serial papers to which allusion has already been made, Mr. W. Phillips describes the rare fungus, *Gyromitra gigas*; Messrs. E. F. and W. R. Linton, in a paper on British hawkweeds, add four more to the already too numerous British species or subspecies of *Hieracium*, viz. *H. graniticolum*, *clovense*, *Boswelli*, and *stenophyes*; in an article on some marine algæ from New Zealand, Mr. R. J. Harvey Gibson describes and figures a new seaweed, *Rhodocorton Parkeri*.

Meteorologische Zeitschrift, June.—On the climatic effect of forests upon their neighbourhood, by E. Ebermayer. The discussion is based upon observations made in Austria since 1866, and the results arrived at are that forests do exert an influence on temperature and humidity, but not to the same extent as mountains and large lakes. Within the forest the daytime is naturally cooler and the nights warmer, while some of the effects are beneficial and others injurious to vegetation. The connection between forests and rainfall is not proved; in any case the effect on local distribution of rainfall is quite subordinate.—Earth temperatures at Hamburg, in the years 1886–91, by W. J. van Bebber. Monthly and extreme values are given at depths of half a metre, and for each metre up to five, together with the temperature of the air and of the surface of the Elbe. The average extreme annual variation, at a depth of 0·5 m. amounts to 30°·6 F., but at a depth of 5m. the variation falls to 8°·1. At the former depth extreme temperatures of 66° and 30° occasionally occur, while at the latter depth temperatures exceeding 52°, or less than 39°, are very seldom recorded.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 15.—"On *Megaladapis madagascariensis*, an extinct gigantic Lemuroid from Madagascar." By C. J. Forsyth Major, M.D., For. Corr. Zool. Soc. (Communicated by Dr. Henry Woodward, F.R.S., V.P.G.S., &c.).

It is now forty-two years since Isidore Geoffrey Ste.-Hilaire announced to the French Academy of Science the discovery of gigantic eggs and a few bones of *Æpyornis* from superficial deposits in the island of Madagascar, anticipating that a rich fauna of extinct vertebrata would be speedily forthcoming.

Little has, however, been added to our knowledge since 1851 until the present time. In addition to the remains of a Crocodile, two Chelonians, and a *Hippopotamus*, first discovered by Grandidier, the number of distinct forms of *Æpyornis* is now rapidly increasing, and promises to rival in variety the New Zealand species of *Dinornis*, whilst the disclosure of a rich mammalian fauna seems only waiting to reward the carrying out of systematic exploration.

Four collections of sub-fossil vertebrates, from various regions of Madagascar, have recently been acquired by the British Museum of Natural History. Amongst one of these, sent over by Mr. J. T. Last (collector for Mr. Grose-Smith), is a somewhat imperfect skull of strange appearance obtained with numerous fragmentary Chelonian, Crocodilian, Hippopotamus, and Æpyornis-remains from a marsh at Ambolisatra on the south-west coast of Madagascar. For this remarkable fossil Dr. Major proposes the name of *Megaladapis madagascariensis*, and the establishment of a distinct family of the sub-order *Lemuroidea*, of which *Megaladapis* appears to be a much-specialised gigantic member, being approximately three times the size of the cranium of the largest existing Lemurid.

The salient features of the skull are the enormous lateral development of the anterior inter-orbital portion of the frontals, extending over the small, thick-walled tubular orbits. The post-orbital frontal region is comparatively narrow and elongate, and separated by a slight contraction from the equally narrow parietal region, bearing a thick and flattened sagittal crest. The brain-case is low, short, and narrow, and placed at a considerably higher level than the elongate facial portion. Both the cranial and facial portion are somewhat bent upwards, the former posteriorly, the latter anteriorly. A striking general character is the remarkable *pachyostosis* (thickening) of the cranium.

The author points out that, in its peculiar features, this skull

only carries to an extreme characters which are present, but in a much lesser degree, and in varying gradations, in the different members of the *Lemuroidea*, both recent *Lemuridæ*, and extinct *Adapidæ*. In the very simple pattern of the molars, the superior of which are of the pure tritubercular type, *Megaladapis* approaches closely to the Malagasy Lemurids *Lepidolemur* and still more to *Chirogaleus*.

The diminutive size of the brain-case (comparable only with what we find amongst the Marsupialia and the Insectivora) is viewed by the author, in this instance, as a degeneracy, other characters being equally indicative of a retrogressive evolution undergone by this Lemuroid.

It is strongly insisted upon, generally, that "low" organisation in Mammalia is by no means always synonymous with "primitive" organisation, and that retrogressive evolution is more frequently to be met with amongst Mammalia than is generally admitted.

As regards the geological age of *Megaladapis* and its associated fauna, one of whose members, the *Crocodilus robustus*, is still living in the lakes of the interior, evidence of various kinds goes far to prove that these sub-fossil remains represent a fauna which was living at a comparatively very recent period, and that man himself was also contemporary with it, and in part responsible for its destruction.

The author adduced evidence in support of the proposition that an older Tertiary vertebrate fauna will ere long be forthcoming in Madagascar.

"On Operators in Physical Mathematics. Part II." By Oliver Heaviside, F.R.S.

It is first shown how the ascending and descending series for the first cylinder function may be algebraically harmonised. If A is the ordinary ascending series in even powers, B the equivalent series in odd powers, and C the equivalent descending series which is most useful for numerical calculation, then $C = \frac{1}{2}(A+B)$. This contains the explanation of a former anomaly. A and C were known to the author to be equivalent as operators, also algebraically and numerically equivalent with positive argument. But when the argument is a pure imaginary A remains real, whilst C becomes complex. A becomes the original oscillating first cylinder function. C contains it and the second oscillating function as well. But the identity $C = \frac{1}{2}(A+B)$ explains it. Both sides remain identical when the argument is imaginary. The second oscillating function is brought in by B.

The generalised formula of which C is an extreme case is then investigated.

The extreme forms of the binomial theorem are then examined. It is shown that when the index is a negative integer the generalised formula becomes indeterminate, consisting of the two extreme forms combined in any ratio.

A more general operator and the equivalences to which it leads are then examined. There is sometimes satisfactory equivalence for numerical purposes by employing only the initial convergent portion of the divergent series, but this fails when the index of the operator is in the neighbourhood of a negative integer.

The general question of the meaning of equivalent and of divergent series is then discussed. The difference stated by Boole to exist between divergent series of the alternating and of the continuous type, in that the former may, whilst the latter cannot, be employed for calculation, appears to be groundless. They are alike in the respect alluded to. But the true meaning of numerical equivalence is unsettled, for there are many cases in which formulæ believed to be analytically and algebraically equivalent show no visible numerical equivalence.

Some generalised formulæ involving the logarithm are then discussed, and some independent verifications found. A formula for Euler's constant is obtained and examined.

One of these formulæ brings in the second cylinder function, which is discussed by means of an operator leading to it; also its connexion with the first solution, and of both with the corresponding two oscillating functions. Various analogies are pointed out, especially through an operator containing two differentiators, leading to elastic wave solutions. Some applications and extensions will follow in Part III.

"On a Failure of the Law in Photography that when the Products of the Intensity of the Light acting and of the Time of Exposure are Equal, Equal Amounts of Chemical Action will be produced." By Capt. W. de W. Abney, C.B., F.R.S.

The above law has been generally assumed. In some recen experiments, however, I have discovered that this law breaks down under certain conditions. Quite lately I have described the method of comparing the photographic value of sunlight with that of candle light (*Photographic Journal*, June, 1893), which was as follows:—A beam light would be admitted through a narrow slit to sensitive bromide paper stretched round a drum of about 4 inches in diameter. The drum could be caused to rotate round its axis at any speed up to about sixty revolutions per second, by means of an electromotor. Part of the experiment was to place an amyl acetate lamp in position at any convenient distance from the slit exposure being given for a fixed time during rotation. The slit was next replaced by a small square aperture, of some $\frac{1}{2}$ inch side, and other portions of the same paper were exposed to the amyl acetate light at the same distance, for varying but known exposures, with the drum at rest. On development the paper showed, amongst other things, a narrow band of deposit of the width of the slit caused by the light from the amyl acetate lamp, and a row of squares of varying blackness of deposit due to the different exposures given with the drum at rest.

By comparing the blackness of the band with the scale of blackness, the width of the slit would evidently be calculated, supposing the usually accepted law to hold good under all circumstances. On making such calculations in every case the calculated width of the slit was always considerably less than what it was in reality, the difference being far beyond that which would be caused by any error in the measurement. This led to an investigation into the cause of this difference.

The following experiment was made. The circumference of the drum with the paper stretched round it was 12·25 in. The width of the slit was arranged to be 0·012 in. The amyl acetate lamp was placed 2 feet from the slit, and a rotation of 30 per sec. was given to the drum for one exposure, and 1 per sec. for a second exposure. In the first case the time of exposure during each revolution was $\frac{0{\cdot}012}{12{\cdot}25} \times \frac{1}{30}$ sec., or about 1/30,000 sec.

The sum of the exposures during 20 min. was thus 1·176 sec. In the other case the exposure was

$$\frac{0{\cdot}012}{12{\cdot}25}, \text{ or about } 1/1000 \text{ sec.},$$

and the sum of the exposures was, as before, 1·176 sec. Thus the first individual exposures had only $\frac{1}{30}$ of the duration of the second exposures, though in the aggregate they were the same.

A scale of blackness was made on the same paper, through a square aperture, without shifting the lamp, the exposures being $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 4, and 8 sec. The scale and blackness of the bands were measured accurately, and the times of exposure which had been given to each band, on the assumption that the law enunciated held good, was calculated and found to be for the first band 0·6 sec., and for the second band 0·91 sec., instead of 1·176 sec. which was really given in all. Another example is where the slit was opened to 0·11 in., and the time of exposure reduced from 20 to 10 min. It was found that in this case the exposures given on the same assumption were 3·7 sec. and 5·28 sec., the real exposure given being 5·36. Other experiments are quoted.

It is to be remarked that the more sensitive a surface is to radiation the less marked are the differences observable for the same speeds of rotation. This is what might be expected.

As an outcome of the experiments so far made, it seems that when exposures less than 1/1000 sec. are made, and the source of illumination is an amyl acetate lamp (Von Altneck's) placed 1 foot from the sensitive surface, the law fails.

The question of very low intensities of light acting, and of the sensitiveness to different spectrum colours, is now under consideration.

[*Note by the author.* It may be stated that it has subsequently been proved that the law equally fails where feeble intensities of light act on the sensitive surface.]

Geological Society, June 21.—Dr. H. Woodward, F.R.S., Vice-President, in the chair.—The following communications were read:—On composite dykes in Arran, by Prof. J. W.

Judd, F.R.S. The author proposed to apply the term "composite dyke" to any fissure which contains two or more distinct varieties of igneous rock, differing from one another in chemical composition or mineralogical constitution. Such dykes fall into two classes:—(1) Dykes in which differentiation has evidently taken place in the materials after their injection, as in the examples described by Dr. Lawson in Canada and by Prof. Vogt in Norway. (2) Dykes in which there is evidence of the reopening of the fissure after its first injection and the introduction of materials of totally different composition. It is this class of dykes of which such interesting illustrations are found in Arran. These Arran dykes belong to the latest volcanic eruptions of the British Islands; their analogues are found alike in the south of Scotland, and in the north of England and of Ireland. They are the infilled fissures along which sporadic volcanic outbursts took place after the extinction of the great volcanoes of the Inner Hebrides. The subaerial products of these later, and, for the most part, insignificant volcanic eruptions, have been all swept away by denudation, except at Beinn Hiant and the Sgûr of Eigg. The materials filling these dykes belong to two totally different classes—one distinctly basic, with about 55 per cent. of silica; and the other markedly acid in composition, with from 65 to 75 per cent. of silica. The basic rock is an augite-andesite, which passes sometimes into an intersertal and occasionally into an ophitic dolerite (tholeite and diabase); the glass of this rock shows a great tendency to separate from the phenocrysts. The acid rock is often a highly vitreous material ("pitchstone" or "pitchstone-porphyry") which by devitrification passes into various forms of felsite and quartz-felsite. These rocks, if we class them according to the nature of the porphyritic minerals they contain, fall into the several groups of vitrophyric and trachytoid lavas, to which the terms pantellerite, quartz-pantellerite, rhyolite, andesite, and dacite have been applied. The glassy groundmass in the whole of these rocks, however, is always abundant and its characters are remarkably uniform however much the phenocrysts may vary. The author pointed out that, while the peculiarities of the first class of composite dykes can be accounted for by selective crystallisation and liquation going on within the magma which has been injected into the dyke, no such explanation is sufficient in the case of the composite dykes of the second class. That the association of two totally different rocks in the same dyke is not accidental, the numerous and varied examples at Tormore sufficiently prove. Where, as in these cases, it is found that there is the greatest dissimilarity between both the crystals and the glassy groundmass of the two rocks, the differentiation has taken place in the magma, prior to its injection into the dykes, and before the work of crystallisation had commenced. Prof. Bonney, Mr. W. W. Watts, Mr. Hulke, and Mr. Teall took part in the discussion on the paper, and the author briefly replied.—Notes on an intrusive sheet of diabase and associated rocks at Robin Hood, near Bassenthwaite, by J. Postlethwaite. The positions of the outcrops of the igneous rock were described, and a grit-band was recorded as running parallel to the diabase. The diabase, and vein-stuff associated with it, have furnished antimony, lead, copper, and arsenic; and the same ores, with the exception of the last two, were also found in minute grains in the grit. Analyses of the grit and diabase have been made by Messrs. Hellon and Brockbank. Prof. Bonney has examined slides submitted by the author, and allowed his notes to be used in the paper. The igneous rock has produced slight metamorphism in the surrounding rocks of the Skiddaw Slates.—On two dinosaurian teeth from Aylesbury, by R. Lydekker. Two teeth from the neighbourhood of Aylesbury, believed to be of Portlandian age, were referred to the sames species as a tooth figured by De La Moussay from the Portlandian of Boulogne. The Aylesbury teeth were described, and the nature of the animal which possessed them was discussed.—On a new plesiosaur from the Waipara River, New Zealand, by Capt. F. W. Hutton, F.R.S. This specimen was shortly described by Sir James Hector in 1873. The author considered it more prudent to follow Mr. Lydekker in referring all the known New Zealand Cretaceous Sauropterygians to Leidy's genus *Cimoliosaurus*, and he therefore described this form as a new species of that genus.—Observations on the affinities of the genus *Astrocœnia*, by Robert F. Tomes. Researches recently made by the author relative to the structure of certain undoubted *Astrocœnia* of the Gosau beds, having for their primary object the better understanding of the supposed species of the genus obtained from the Glamorganshire conglomerate, have been productive of results which will render a complete modification in the classificatory position of the genus imperative. The author gave a new definition of the genus, in which he did not include any species of an earlier date than the cretaceous period, all the so-called Jurassic *Astrocœniæ* being referable to other and quite distinct genera.—Description of a new genus of *Madreporaria* from the Sutton Stone of South Wales, by Robert F. Tomes. In the *Quarterly Journal* for 1885 is a detailed description of a coral from the Sutton Stone named *Astrocœnia gibbosa*. This specimen is not the type of the species, and a re-examination of it by the author has proved that it is not an *Astrocœnia*. Two other specimens have also been examined, and as a result of examination of the three the author is enabled to found a new genus *Styloseris*, of which a diagnosis was given, and the specific name *gibbosa* was retained for this, the only known species. The genus will take its place near *Clausastræa*, from which it differs by possessing a well-developed columella and increasing by both fissiparity and gemmation. Mr. Etheridge and Dr. G. J. Hinde took part in the discussion that followed.—Study of the dykes of Hope, Idaho, by Herbert R. Wood. A description was given of the geographical distribution and characters of acid and basic dykes traversing slates and quartzites along the northern shore of Lake Pend'Oreille, Idaho, accompanied by notes on the glaciation of the area. The microscopic features of the igneous rocks were also described.—The rise and fall of Lake Tanganyika, by Dr. Robert Sieger. The author referred to Mr. Carson's paper on the same subject in the Society's Journal for 1892. He himself believed the oscillation of level to be analogous to variations reported as occurring in other African lakes, and to be due to climatic change. He brought forward evidence in favour of the coincidence of change of level and climatic change, but did not believe that his views are by any means contradictory to those of Mr. Carson, for the phenomena may be explained by a combination of the influences of climate with those of mechanical agencies.—On Cheilostomatous Bryozoa from the Middle Lias, by Edwin A. Walford. The author described some forms of bryozoa from the *spinatus*-zone of the Middle Lias near Banbury, some of which had previously been classed with the Cyclostomata. The new material not only shows the opercular aperture but the opercula *in situ*, together with appendages and supra-oral ovicells characteristic of the Cheilostomata. In addition he also found giant cells (cistern-cells) of form quite dissimilar from the ordinary zoœcia and probably reproductive. He cited M. Jules Haime as having described in his magnificent monograph somewhat similar cells from the Inferior Oolite; and in the Oxfordshire Great Oolite bryozoa Mr. Walford found cistern-cells like the Lias species on some colonies like *Diastoporæ*. He contended that it is merely the acquisition of very well-preserved material which is needed to show the necessity of removal of many such species to the Cheilostomata. The name *Cisternophora* was suggested for the genus, of which several forms were described.

Royal Microscopical Society, June 21.—The Rev. Canon Carr in the chair.—Dr. J. E. Talmage, of Salt Lake City, Utah, exhibited and gave an account of some specimens of selenite found in the interior of a mound at South Wash, near Fremont River, Utah. As a rule, portions of selenite useful for optical purposes are measured by inches and weighed by ounces, but here he had found some which weighed 1000 lbs. The formation around the mound was mostly sand and clay, and the region bore everywhere strong evidences of weathering, by means of which the mound had been weathered out into relief. He had removed some twenty tons of the crystals, amongst which were many single crystals, measuring 4 to 5 feet in length, and entirely perfect, the most regular being 4 feet long with faces of 6 inches. One fine crystal, 5 feet long, had no less than nineteen small ones jutting out from it; twins and groups were also very common. Inclusions of sand, clay, and liquid were often present. He believed this to be a unique formation.—Mr. G. C. Karop read a letter on the subject of diseased beard-hairs.—Prof. T. Jeffrey Bell read a letter from Capt. Montgomery on the subject of chicken-lice, ticks from grass, and other parasites found in Natal.—Dr. Nias read a paper on the development of the Continental form of microscope.—A discussion ensued, in which Dr. Dallinger, Dr. Braidwood, Mr. Karop, Mr. Teasdale, and the author took part.—Mr. C. Rousselet gave a *résumé* of his paper on *Floscularia pelagica* and other new rotifers.

EDINBURGH.

Royal Society, June 19.—The Hon. Lord Maclaren, vice-president, in the chair.—Dr. H. R. Mill communicated a paper on the physical geography of the Clyde sea area. He considered specially the question of the distribution of temperature, discussing the observations made by the Scottish Marine Station staff on the West Coast of Scotland for March 1886 to October 1888, along with some other earlier and later observations made by Mr. J. Y. Buchanan and the Fishery Board for Scotland. In the North Channel, between Scotland and Ireland, the temperature was uniform from the surface to the bottom because of the action of the tides in mixing the water. The yearly average of the temperature of the Channel water was 2 degrees higher than that of the air of the Mull of Cantyre. The air temperature reached its maximum in the end of July, while the water temperature was greatest in the middle of September. The temperature varied greatly from surface to bottom on the broad shallow which stretches from Cantyre to Galloway, except at the time of the annual minimum, when it became uniform. The Channel water mixes there with the water from the great Arran basin. In that basin the temperature is the same from the surface to the bottom at the spring minimum in March, the lower layers being only slightly affected during the year—most so at the autumn maximum. The surface layers heat and cool rapidly; but the average temperature of the whole is always lower than that of the Channel, except for a month at the spring minimum. The maximum temperature in the basin occurs in October. In the more isolated sea lochs, such as Loch Fyne and Loch Goil, the absence of oceanic influence is more marked. Thus in Loch Fyne, though the temperature is nearly the same as at other places at the minimum period, it is colder during the rest of the year, and the difference between the surface and bottom temperatures is more marked.

July 3.—The Hon. Lord Maclaren, vice-president, in the chair.—Prof. J. Gibson read a paper on the chemical composition of sea-water.—Dr. Alex. Buchan described a diagram exhibiting the hourly variations of rainfall at Ben Nevis Observatory. The diurnal variations at Ben Nevis Observatory are much more marked than those at any other station on the globe from which Dr. Buchan had been able to get observations.—Prof. Tait gave a further discussion of the path of a rotating spherical projectile.—Dr. Noel Paton communicated a paper by Dr. Chasseaud on an experimental study of intra-ocular therapeutics.

DUBLIN.

Royal Dublin Society, June 21.—Prof. G. A. J. Cole in the chair.—The following papers were read:—Note on a graphitic schist from County Donegal, by Mr. R. J. Moss. The schist yielded on analysis a little over three per cent. of carbon.—On some Pycnogonida from the Irish coasts, by Mr. G. H. Carpenter. Eight species are enumerated, including two forms of *Phoxichilus*; and the various species are considered by the author to be so nearly related as to indicate that they are as yet but in process of differentiation.—A paper was communicated by Prof. A. C. Haddon on the post-embryonic development of fungia, by Captain Gilbert C. Bourne.

NEW SOUTH WALES.

Linnean Society, May 31.—Prof. David, President, in the chair.—The following papers were read:—Descriptions of new Australian Lepidoptera, with additional localities for known species, by T. P. Lucas.—Australian plants illustrated. No. v. *Angophora subvelutina*, F.v.M., by R. T. Baker.—The Silurian Trilobites of New South Wales. Part 2. The Genera *Prœctus* and *Cyphaspis*, by R. Etheridge, Jun., and John Mitchell.—Description of a new *Murex* from South Australia, by John Brazier.—Mr. Brazier exhibited a specimen of the South Australian *Murex polypleurus*, n.sp., described in his paper, a species which in the past, by the late Mr. G. F. Angas and other authors, has been confused with *M. pumilus*, A. Ad., from the China Sea, and Darros Island, Amirantes. Also a fossil specimen of *M. octogonus*, Q. and G., from New Zealand.—Rev. J. Milne Curran read a note recording the presence of a fossil Buprestid beetle in an earthy limonite at Inverell, N.S.W. The insect is represented by a portion of a metallic green elytron, and it is associated with Miocene fossil leaves and a species of *Unio*. He also showed a specimen of a Silurian fossil coral (*Heliolites*) from Molong, N.S.W., in a beautiful state of preservation.—Mr. Baker exhibited drawings and specimens in illustration of his paper.—Mr. Trebeck showed a specimen of a large freshwater prawn (*Palæmon ornatus*, Oliv.) from the Rewa River, Fiji.—Mr. C. T. Musson sent for exhibition specimens of a European slug, *Arion hortensis*, Müll., from New Zealand, where it is now not uncommon, though not yet recorded from Australia. Also, from the Kurrajong, N.S.W., specimens of the peculiar slug *Cystopelta petterdi*, Tate.

PARIS.

Academy of Sciences, July 10.—M. Lœwy in the chair.—Note on the history of the facts which have proved the existence of the coronal atmosphere of the sun, by M. J. Janssen.—Natural introduction of terms proportional to ether displacements (Briot's terms) in equations of motion of light waves, by M. J. Boussinesq.—On the relation which exists between the co-efficients of the formulæ of Coulomb (the magnetic formula), of Laplace and of Ampère, by M. E. H. Amagat.—On a differential equation of the second order, by M. Mittag-Leffler.—Proper vibrations of a medium indefinitely extended outside a solid body, by M. Marcel Brillouin. Investigating the infinitely small proper motions of an infinite gaseous atmosphere external to a sphere which is deformed in any manner and then rendered motionless, M. Brillouin arrives at an equation which defines the pitch and quality of the sound emitted by the sphere, and also plays an important part in the motion of solids inflaids. Thus the form and dimensions of the bullet define the pitch and the damping of the sounds produced; the form of the vessel defines the periods of the different waves which it produces whatever may be its (small) velocity, the longest waves playing an important part in the resistance experienced. Thus, also, the presence of a rigid obstacle in a solid elastic medium determines the periods proper to the external medium, characterising the form and the properties of the body. There is every reason to believe that the waves emitted by metallic vapours correspond for the greater part to vibrations peculiar to the external ether, as will be shown in a detailed study of optical theories about to appear in the *Annales de Chimie et de Physique*.—On the realisation of constant temperatures, by M. Gouy. A criticism of M. Berget's work to determine the constant of gravitation, on the ground of the enormous difference produced in the gravimeter by a small difference of temperature.—On the electric transference of heat in electrolytes, by M. Henri Bagard. Two cylindrical glass tubes are fixed vertically in the corks of two vessels into which a current is conveyed so as to pass into the first vessel, up through the first tube into a reservoir containing a solution of some salt like zinc sulphate, down through the other tube and out by the other vessel. The lower portion of the tubes is kept at a lower, the upper at a higher temperature. A distinct Thomson effect was observed on sending a current from twelve small Daniell's through the arrangement, heat being conveyed in the direction of the current, as was easily shown by the variation of resistance, which in liquids decreases rapidly at higher temperatures.—On pyrosulphochromic hydrate, by M. A. Recoura.—On the combinations of selenious acid with molybdates, and on molybdoselenious acid, by M. E. Péchard.—On the iodosulphides of arsenic and antimony, by M. L. Ouvrard.—On the dissociation of calcium plumbate, by M. H. le Chatelier. In Kassner's process for the manufacture of oxygen, the following reaction is utilised:

$$PbO_2.2CaO = PbO + 2CaO + O.$$

Experiments were made with a view of determining the advantages or otherwise of this process as compared with barium peroxide. It was found that the disadvantage of the new method lay in the fact that it required a temperature of 900° instead of 700° for the oxygen to be dissociated at a pressure of 0·1 atmosphere. On the other hand, the plumbate, being easily fusible, absorbs oxygen more rapidly and completely, and the air need not be previously desiccated and decarbonated.—On benzoylcinchonine, by M. E. Léger. Action of sulphuric acid upon pyrocatechine and upon homopyrocatechine, by M. H. Cousin.—On a process of directly combining ethylenic and aromatic carbon compounds, by M. A. Bouchet.—Attempt at the diagnosis of isomeric amido-benzoic acids and some other aromatic compounds, by M. Ekhsner de Coninck.—On geraniol, by M. Ph. Barbier.—Influence of the acidity of musts

upon the composition of the phlegms, by M. L. Lindet.—Greater assimilability of the nitrogen from recently formed nitrates, by M. P. Pichard.—On the composition of lime-tree "honey," by M. Maquenne.—On a new terrestrial Gregarina of the melolonthid larvæ of Provence, by M. Louis Léger.—On the *rôle* of the reserved secondary tissues of arborescent monocotyledons, by M. H. Jacob de Cordemoy.

BERLIN.

Physiological Society, May 19.—Prof. du Bois Reymond, President, in the chair.—Dr. Benda, in continuation of his remarks at the last meeting, spoke on certain questions connected with cell-division, dealing first with the value of double-staining. He then made a communication on the extra nuclear origin of the nuclear spindle and its relation to the centrosoma, and lastly on the median cell discovered by Flemming, which appears after the equatorial transverse division has become formed in the dividing cell.—Prof. Gad gave an account of experiments made by Dr. Rosenburg on the transplanting of slips of small intestine into the bladder. The experiment was successful; the functions of the bladder remained normal, and investigation showed that the muscular coat of the intestine had grown into that of the bladder, while the mucous membrane had grown up through the flattened epithelium of the organ.

June 9.—Prof. du Bois Reymond, President, in the chair.—Dr. Loewy had gone carefully into the methods of blood-titration, and concluded that the most convenient and certain way of determining the alkalinity of blood is to dilute it with a solution of magnesium sulphate and to add acid until a drop of the mixture just reddens litmus. In connection with this Prof. Zuntz gave an account of some experiments of his own and of Prof. Lehmann on the nature and compounds of the acids and bases of blood. He drew special attention to the results of passing carbon dioxide through blood whereby the alkalis leave the corpuscles and pass into the plasma as the result of a splitting up of their compounds with proteids and their conversion into diffusible carbonates.—W. Townsend Porter communicated the results of his experiments on the coordinating centres of the cardiac ventricle. Starting from the fact that the function of the centres is suppressed when the blood-supply is cut off, he had ligatured the coronary artery, supplying the septum, in a number of animals. In all cases the animals lived for many hours and even days after the operation, from which fact he considered he had disproved the existence of any coordinating centre in the septum.

Physical Society, June 2.—Prof. von Helmholtz, President, in the chair.—Dr. Rubens gave an account of experiments he had made, together with Dr. du Bois, on the permeability of metallic wire gratings to polarised heat rays. As is well known, Hertz's experiments on electric oscillations brought them into close relationship to the properties of light-vibrations, as shown by reflection, refraction, and polarisation. The fact that metallic gratings act as polarisers towards electric waves, inasmuch as the waves can only pass through when the wires of the grating are parallel to them, has no analogue in the case of light, since linearly polarised light can pass through a grating whatever be its position. On the assumption that this difference is dependent simply on the fact that light waves are too small for the gratings employed, the authors had experimented with the longer heat-rays and gratings of extremely narrow aperture. The latter were made of the finest wire (gold, silver, copper, and iron), the intervals between the wires being ·0025 mm., and the rays of a zirconium flame, up to W.L. 6μ were examined. The ocular of the spectroscope carried a very sensitive bolometer. It was found that with each of the gratings the ultra-red rays behaved like electric waves; those rays which vibrated at right angles to the plane of polarisation passed through a grating placed parallel to their plane, in threefold extent, as compared to the amount which passed when the grating was at right angles. This result was obtained with different metals with varying wave-lengths of the rays, *e.g.* with silver by W.L. above 2μ.—Dr. Krigar-Menzel reported on the present state of the experiments he is making together with Dr. Richarz on the diminution of weight at increasing altitudes. A balance is provided at each arm with two pans, one above the other at a distance apart of 2·2 m. With this balance two weights are determined, of which one lies in the upper pan, the other in the lower. The weighings are then repeated on both sides, and thus the difference of the weights when in the upper and lower pans is ascertained. In the next place a massive leaden block is built up between the two pans and the weighings are repeated. Up to the present time the weighings without the lead mass are alone complete. The block is, however, in position, and a few preliminary weighings have been made, from which it so far appears as if the presence of the lead had done away with the difference of the weights when in the upper and lower pans.

[NOTE.—In the report of the Physical Society, NATURE, vol. xlviii. p. 144, column 2, five lines from the top—"the vapours of these metals similarly gave an emission-spectrum following on the absorption spectrum"—for "similarly" read "neither," and for "following on" read "nor."]

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Heat: M. R. Wright (Longmans).—Aids in Practical Geology, 2nd edition: Prof. G. and J. Cole (Griffin).—An Introduction to the Study of the Diatomaceæ: F. W. Mills (Iliffe).—Diagnostik der Bakterien des Wassers: Dr. A. Lustig (Jena, Fischer).—Euclid's Elements of Geometry, Books v. and vi.: H. M. Taylor (Cambridge University Press).—Acoustics, Sound (Advanced), enlarged edition: W. Lees (Collins).—A Study of the Languages of Torres Straits, Part 1: S. H. Ray and A. C. Haddon (Dublin).—The Arctic Problem: A. Heilprin (Philadelphia, Contemporary Publishing Company)—Exploration of Mount Kina Balu, North Borneo: J. Whitehead (Gurney and Jackson).

PAMPHLETS.—Ueber die Typen der Küstenformen: Dr. A. Philippson.—Sir F. Ronalds, F.R.S., and his Work in Connection with Electric Telegraphy in 1816 (Simpkin).

SERIALS.—Medical Magazine, July (Southwood).—The Lingualumina, Parts 1 and 2: F. W. Dyer (London)—Proceedings of the Society for Psychological Research, June (K. Paul)—The Book of the Fair, Part 1: H. H. Bancroft (Chicago, Bancroft).—Botanische Jahrbücher für Systematik Pflanzengeschichte und Pflanzengeographie, Sechzehnter Band, iv. u. v. Heft (Williams and Norgate).—Annals of Scottish Natural History, July (Edinburgh, Douglas).—Notes from the Leyden Museum, July (Leyden, Brill.)

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